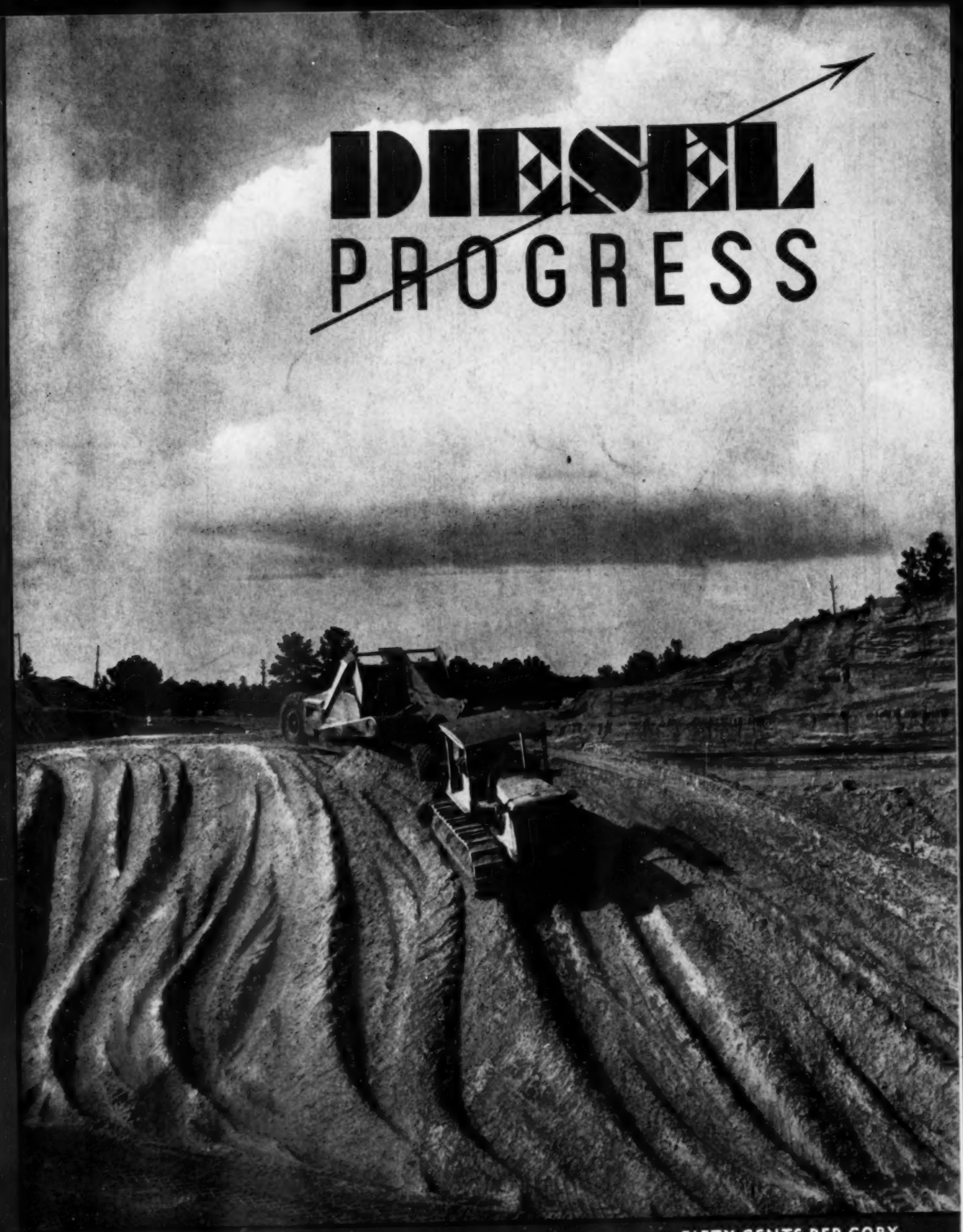
DIESEL PROGRESS

IN INDUSTRY • IN TRANSPORTATION • ON THE SEA • IN THE AIR • UNDERGROUND



FIVE DOLLARS PER YEAR

MARCH, 1949

FIFTY CENTS PER COPY

DIESEL PROGRESS, for March, 1949. Volume XV, Number 3. DIESEL PROGRESS is published monthly by Diesel Engines, Inc., 2 W. Forty-fifth St., New York 19, N. Y. Rex W. Wadman, President. Acceptance under the Act of June 5, 1934, at East Stroudsburg, Pa., authorized Mar 27, 1940. Subscription rates: $5 per year, single copy 50c.

Ask any HARBORMASTER Operator

Built for Hollingsworth & Whitney, Boston, this 39' pulpwood towboat is equipped with Harbormaster Model O-A31, 110 H. P., diesel

Harbormaster
Model O-7
300 H. P., diesel

HARBORMASTER EQUIPMENT

MEANS TOPS IN OPERATING EFFICIENCY AND ECONOMY

It's performance that counts—the amount of work that is done in a certain time. Operating records and repeat orders show that Harbormaster equipment performs outstandingly in many marine fields.

Of course there are definite reasons for these performance achievements. One, for instance — Harbormaster models, ranging from 20 to 300 H. P., deliver real heavy duty thrust power, more per horsepower than any other conventional propelling and steering equipment. To mention another — you go where you steer because Harbormasters steer by the thrust of the propeller, and you can steer in any direction with full power.

There are many other operating and maintenance efficiencies which are yours when your craft is Harbormaster-equipped. Write or wire today for details — on long hauls or congested harbor work, for towboats or work craft, Harbormaster equipment delivers the performance that you'll count in your profits.

Herb Southworth & Co.
110 Market St.
San Francisco, Cal.

Empire Steel Co.
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Houston, Texas

George Engine Co.
1111 Jefferson Highway,
New Orleans, La.

MURRAY & TREGURTHA, INC.

High Fidelity Marine Engines since 1885

18 HANCOCK STREET, QUINCY 71, MASS., U. S. A.

Licensed Manufacturers and Distributors:

SHERBROOKE MACHINERIES, LTD.
Sherbrooke, Quebec

P. FANGHANEL & CO., LTD.
108 Fenchurch St., London, Eng.

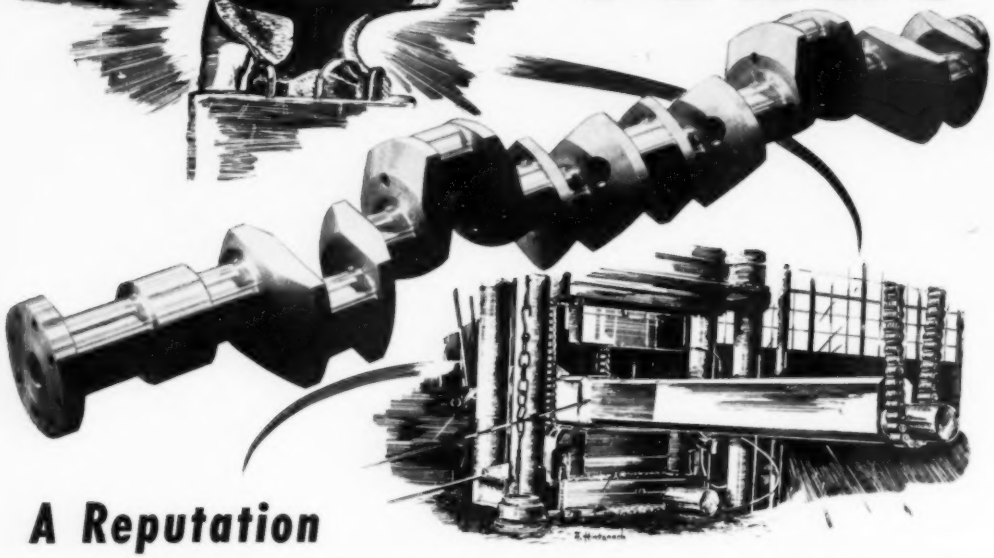
Coast Engineering Co.
P. O. Box 566, Norfolk, Va.

Western Machinery
5075 Manchester Ave.
St. Louis, Mo.

Outdoor Sales Company
Robert M. Nelson
Memphis, Tenn.

Hendrickson & Baker, Inc.
420 Lexington Ave., N.Y.C.

ACROSS THE YEARS



A Reputation for DEPENDABLE, PRECISION WORKMANSHIP ERIE CRANKS!

DURING the past half-century Erie Forge has built a reputation for dependable, precision workmanship. This period of time has seen many changes in the diesel industry . . . new designs, methods and materials. And during that same period Erie Forge has kept abreast of new developments . . . constantly striving to maintain or improve its high level or precision workmanship.

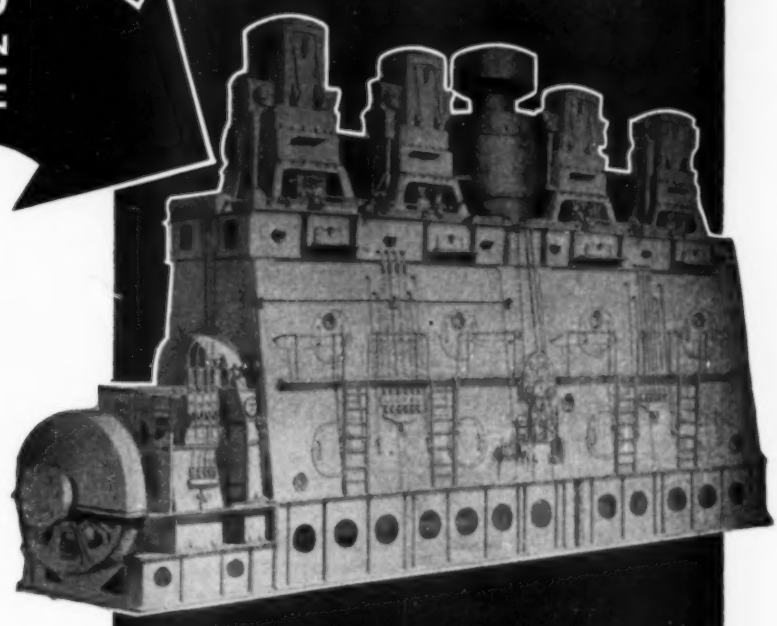
One control—one responsibility is the watch word at Erie Forge. From the raw material to the finished crank the work is under the watchful eyes of our engineers whose job it is to see that every finished product conforms to the high standards of Erie Forge craftsmanship.

Consult with our engineers. Together we will find the right answer.

ERIE FORGE COMPANY, ERIE, PA.

Sturdy MARINE ENGINES

SUN-DOXFORD
2 CYCLE OPPOSED PISTON
DIESEL ENGINE



Dependable
POWER
for
MARINE
INSTALLATIONS

★

Furnished in Sizes
from
1,000 to 10,000 S.H.P.

Since 1916

USNR

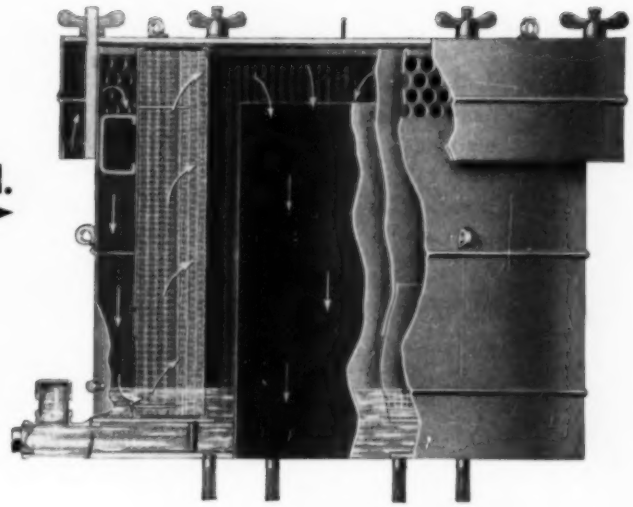
JOIN

SUN SHIPBUILDING and DRY DOCK COMPANY
CHESTER PENNA.

Industry's most advanced air filter —the new Air-Maze "oil bath"

from 25 C.F.M. →

to 6500 C.F.M. →



1. **MORE THAN 97½% EFFICIENT.** Based on laboratory tests with ordnance test dust.
2. **LOWER PRESSURE DROP.** Due to cylindrical media design.
3. **CONTINUOUS OIL WASH.** From idle to full throttle, due to oil-immersed skirt.
4. **ALL METAL, VIBRATION RESISTANT.** Galvanized wire screen media cannot pack or shake down. Constant density throughout.
5. **EASILY DISASSEMBLED.** If necessary, filter element may be entirely removed for cleaning or inspection.
6. **BOTTOM OR TOP OPENING AVAILABLE.** Choose the type that best fits your particular application.
7. **YOUR CHOICE OF FOUR BASE TYPES.** Male or female pipe thread, set screw or flange.
8. **12 CAPACITY SIZES.** A range of sizes to handle large and small engines and compressors.
9. **INTEGRAL BACKFIRE VALVE.** When required for 4-cycle gas engines, filter may be equipped with spring-loaded backfire valve.
10. **RELIEF VALVE FOR COMPRESSORS.** Integral relief valve available on filters used with compressors having free air unloading.

For further details write today to Air-Maze Corporation, 5200 Harvard Ave., Cleveland 5, Ohio, or your nearby Air-Maze representative.

AIR-MAZE

THE FILTER ENGINEERS

AIR FILTERS • SILENCERS • SPARK ARRESTORS • LIQUID FILTERS • OIL SEPARATORS • GREASE FILTERS

Undersea Secret

There's no space to waste in a submarine. And power must be completely dependable. That explains why a majority of submarines in the U. S. Navy are powered with General Motors Diesel-Electric Drive. A product of 37 years' Diesel engineering experience, GM Diesel engines are your best choice for space-saving, dependable, low-cost power.

Outstanding Diesel Developments

GM Diesel-Electric Drive propulsion equipment was first used in a U. S. Navy submarine in 1935.

CLEVELAND DIESEL ENGINE DIVISION
CLEVELAND 11, OHIO
GENERAL MOTORS

GM GENERAL MOTORS DIESEL POWER

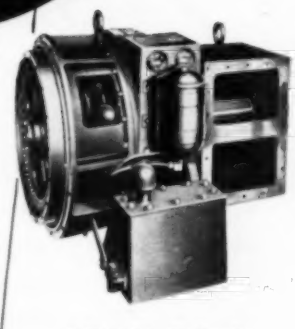
ENGINES FROM 150 TO 2000 H. P.

Eliminates Gear-shift Guesswork

Guesswork as to which gear to use is eliminated when you have a Twin Disc Hydraulic Torque Converter on your excavator . . . your yarder or loader

A Twin Disc Hydraulic Torque Converter automatically selects and transmits the correct output torque and speed for varying loads within its working capacities . . . allows your engine to run at its most efficient speed. Balance between output torque and speed is automatically accomplished without any mechanical speed change. Also, the cushioning effect of the hydraulic unit protects both the engine and the driven parts against destructive shocks.

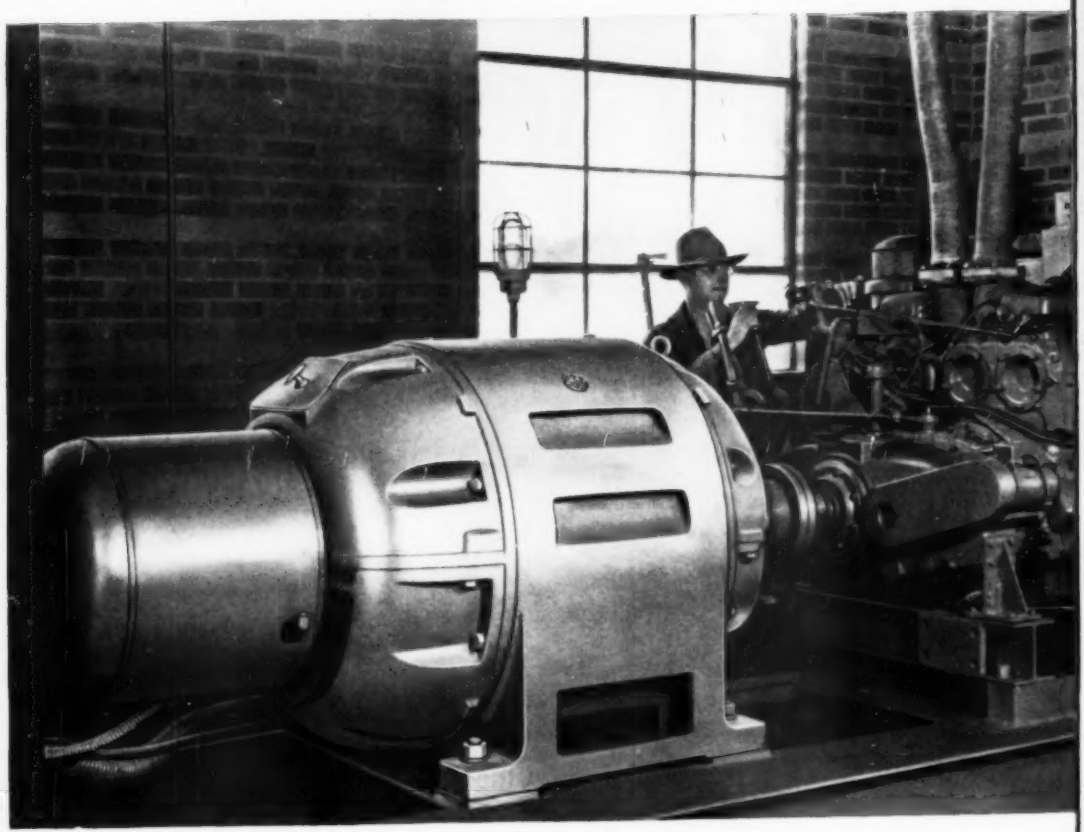
Write the Twin Disc Clutch Company, Racine, Wisc., for Bulletin No. 135A which tells the complete story of the advantages obtainable when a Twin Disc Hydraulic Torque Converter is installed. TWIN DISC CLUTCH COMPANY, Racine, Wisconsin (Hydraulic Division, Rockford, Illinois).



A Twin Disc Hydraulic Torque Converter (Lysholm-Smith type).

SPECIALISTS IN INDUSTRIAL CLUTCHES SINCE 1918

for Appearance



for Compactness

Beaumont Buys General Electric

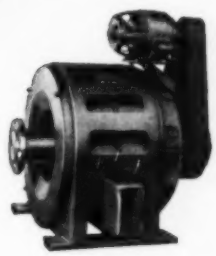
The City of Beaumont, Texas, had a problem when they installed a standby power plant for their water plant. A diesel-driven generator was chosen for efficiency and operating economy. But the new plant had to be compact—it was installed in an existing building with no special foundations and low headroom. The plant had to operate dependably with a minimum of attention and maintenance.

Electrically, the Tri-Clad high-speed synchronous generator gave all the right answers. Smooth contours and a compact frame are external evidence of a complete redesign. Tri-Clad high-speed synchronous generators incorporate the convenience and protection features of the industry-proved Tri-Clad induction motors. You get extra protection and convenience plus smooth, attractive appearance when you couple Tri-Clad high-speed synchronous generators to your diesels.

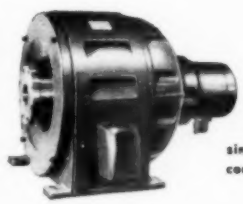
Contact your nearest G-E sales representative for more information. Ask him about ratings, modifications, and shipment. You can get the generator you need quickly. ***Apparatus Dept., General Electric Co., Schenectady 5, N. Y.***

YOU GET VERSATILITY, TOO! There are modifications to fit every requirement:

standard generator for direct-coupling, belt- or chain-drive



top-mounted exciters



single-bearing direct-coupled generator

GENERAL ELECTRIC

Apparatus Dept., Sec. B 770-3
General Electric Company
1 River Road
Schenectady 5, N. Y.

Gentlemen:

Please send me a copy of GEA-5125 that gives me more information on Tri-Clad high-speed synchronous generators.

Name .....

Company .....

Street .....

City ..... **State** .....

A BIG OK ON THE KATY

IN April 1947, the Missouri-Kansas-Texas Railroad placed General Motors passenger locomotive No. 101 in service. Through June 1948, this 4,000 H.P. Diesel met assignments 100%.

The record of General Motors Diesels in freight service on the Katy is equally brilliant. As shown by the performance table below, seven General Motors Diesel freight locomotives in their first year of operation rolled up a total of 1,130,156 miles out of 1,144,376 miles assigned. Operating on fast daily schedules between Oklahoma, Texas and the North, they handled crack Katy freights an average of 13,697 miles per month, with a record of 98.76% availability based on assignment.

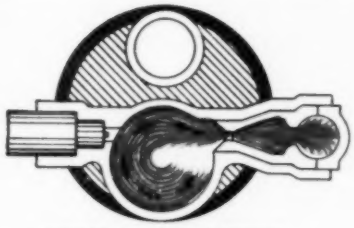
PERFORMANCE OF GM DIESEL FREIGHT LOCOMOTIVES ON M-K-T

Loco. No.	Month Delivered	Total Miles Assigned	Total Miles Operated	Avg. Miles Operated Per Month	Per Cent of Assignment Filled
201	6-47	164,012	161,538	12,996	98.49
202	6-47	172,715	170,453	13,746	98.69
203	7-47	160,689	158,716	13,742	98.77
204	7-47	163,776	162,335	13,934	99.12
205	7-47	161,408	159,468	13,771	98.80
206	7-47	162,578	161,130	14,036	99.11
207	7-47	159,198	156,516	13,705	98.32
	TOTAL	1,144,376	1,130,156	13,697	98.76

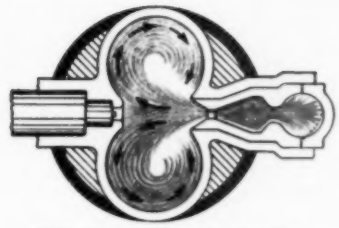
ELECTRO-MOTIVE

GENERAL MOTORS LOCOMOTIVES

DIVISION OF GENERAL MOTORS • LA GRANGE, ILL. • *HOME OF THE DIESEL LOCOMOTIVE*



SINGLE LOBE TYPE



DOUBLE LOBE TYPE

(Left) Representative examples of the two different Lanova combustion chamber designs. Note the organized rotary stirring action that is developed to promote complete burning of fuel.

THE LANOVA COMBUSTION SYSTEM

Here is the "heart of the Diesel engine"—the Lanova Combustion System. At the instant pictured, you see the violent blasting tornado set up when raw fuel is changed into power. Unlike the destructive forces of nature, this tornado is controlled and timed. It produces an organized rotary turbulence which thoroughly mixes fuel with the air needed to support complete combustion.

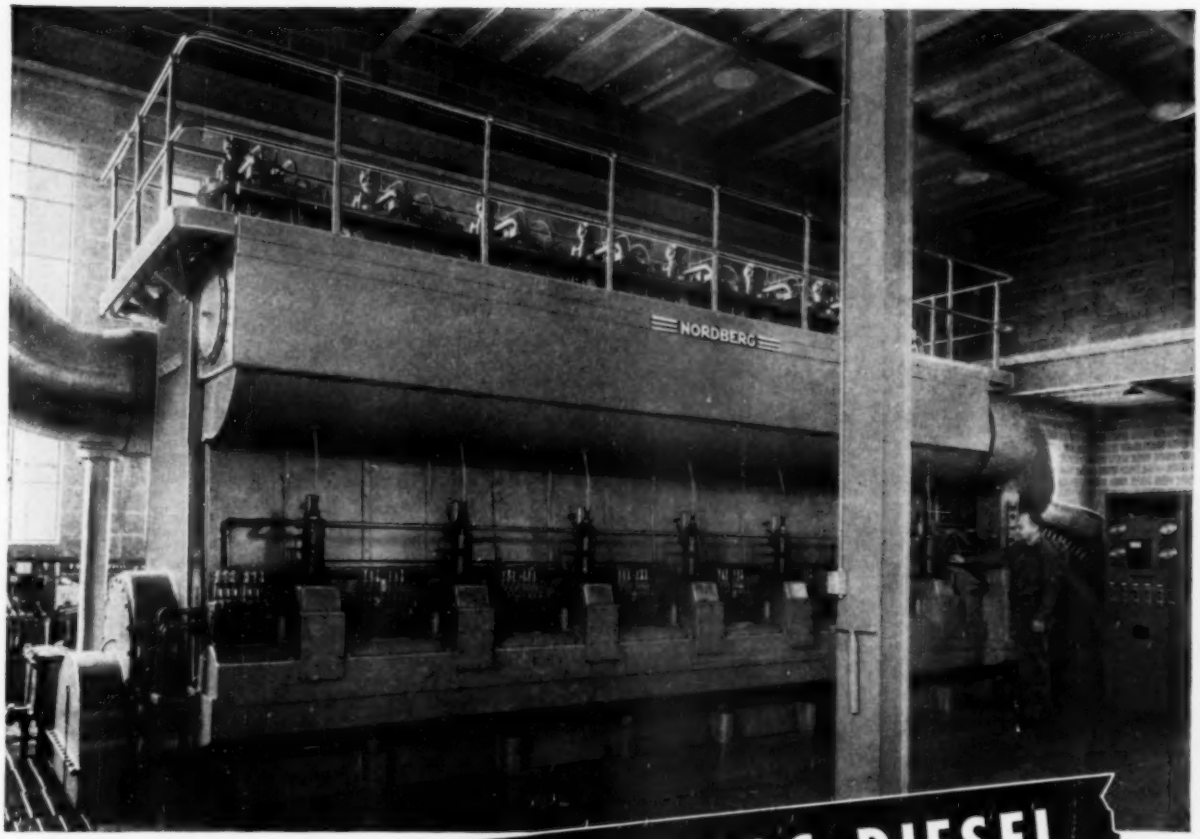
This controlled rotary turbulence, an exclusive feature of the Lanova Combustion System, makes a major contribution to the high efficiencies and excellent fuel economies of Lanova-type Diesels. It pays off in lower operating and maintenance costs.

So, when you buy your next Diesel, be sure to check and see if it has the Lanova Combustion System. You can identify it by its characteristic energy cell design.

WHERE TO GET LANOVA-TYPE DIESELS

The Lanova System is available only in Diesels manufactured by Lanova licensees. We'll be glad to send you the complete list of these outstanding engine builders. LANOVA CORPORATION, 38-19 30th St., Long Island City 1, N. Y.

LANOVA *makes Diesels purr*



2800 H.P. NORDBERG DIESEL

. . . for the Michigan Public Service Company

• The Michigan resort country around Montague is another in the ever-increasing list of areas served by Nordberg Diesel Engines. This 2800 B.H.P. unit was recently placed in service in one of the generating stations of the Michigan Public Service Company.

The basic dependability of Nordberg Diesels is no idle claim—*it's a fact,* proved in service on hundreds of successful power applications . . . from the smallest to the largest engine, every Nordberg unit is built to deliver low-cost, trouble-free power for main or standby service.

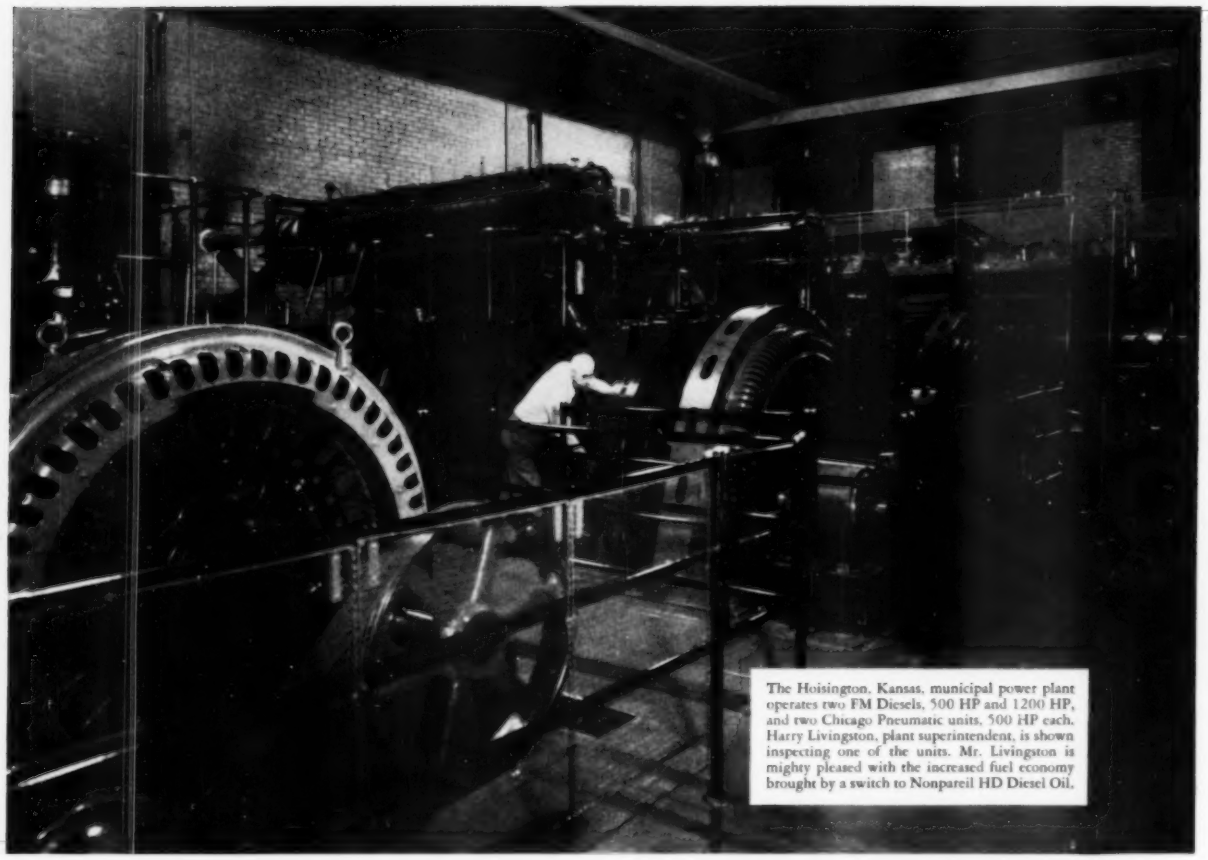
In the complete line of Nordberg two and four-cycle Diesel engines, including both oil and gas burning types, you will find exactly the right unit to meet your present and future power requirements . . . from 10 to 8500 B.H.P.

NORDBERG MFG. CO.
MILWAUKEE 7, WISCONSIN

P349

A DIVISION OF NORDBERG

NORDBERG
DIESEL ENGINES



The Hoisington, Kansas, municipal power plant operates two FM Diesels, 500 HP and 1200 HP, and two Chicago Pneumatic units, 500 HP each. Harry Livingston, plant superintendent, is shown inspecting one of the units. Mr. Livingston is mighty pleased with the increased fuel economy brought by a switch to Nonpareil HD Diesel Oil.

Gets greater fuel economy...

THE DIESELS at the Hoisington, Kansas, municipal power plant were put in operation in 1938 on straight mineral oil lubrication. As the load increased, carbon and varnish deposits showed up in the engines.

Operators took the advice of a Standard Oil Lubrication Engineer. They shifted the Diesels to a superior heavy-duty lubricant—Nonpareil HD Diesel Oil.

No mechanical changes were made. Nonpareil HD alone solved the problem... and then some! Deposit troubles were completely eliminated. Operators reported an increase in power output of nearly *one kilowatt-hour* for each gallon of fuel oil used.

This increase in engine efficiency officials attributed to cleaner and more effective lubrication by Nonpareil HD Diesel Oil.

Nonpareil HD Diesel Oil

That's your clue to more economical Diesel operation! Shift to Nonpareil HD and get the benefits that this superior lubricant has proved it can give.

If your plant is located in the Midwest, write Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois, to secure the services of the Standard Oil Lubrication Engineer nearest you.

STANDARD OIL COMPANY (INDIANA) STANDARD

Important Questions..

about iron and steel scrap for every top business man in every industry

Q. *How* bad *is the shortage of scrap?*

A. Actually, we have enough scrap to get along, but too much of it is *light* scrap. What is badly needed today is more *heavy* scrap.

Q. *Why more* heavy *scrap?*

A. Because heavy scrap will produce *more and better* steel in *less* time.

Q. *Why is the heavy scrap shortage so* harmful *to our economy?*

A. Half of all the ingredients that are melted to make steel and castings consists of scrap iron and steel. The short supply of heavy scrap during the past year limited the production of steel mills and foundries. At the present record rate of production, there is still not nearly enough steel to meet the current and anticipated demands of our domestic economy, military requirements, and ERP. More heavy scrap will help bridge the gap.

Q. *What's being* done *about it?*

A. A drive . . . and everybody is cooperating . . . is being started for industrial scrap, to (1) help step up present steel production, and (2) *create a visible reserve of heavy scrap in the event of national emergency.*

Q. Why *is there a shortage of heavy scrap?*

A. Several reasons:

1. Very little of the 123,000,000 tons of steel and steel products exported during the war has come back as scrap.
2. With replacements scarce and expensive, much old equipment which would normally have been junked by now, is still in use.
3. A halt has been called on the junking of old vessels and military equipment which has until recently been a source of scrap.
4. The amount of heavy scrap produced in fabrication —the left-overs of machinery, etc.—is not enough to meet the demand for new steel and castings.

Q. *How about the heavy scrap that must exist in huge quantities in* Germany *and* Japan?

A. Some of this will be coming through, but not in good quantities until preparation and transportation facilities within those countries improve.

Q. *Where can* additional *scrap be obtained from domestic sources?*

A. From industrial plants which have on hand large amounts of heavy scrap in the form of obsolete machinery, idle equipment—tools, dies, jigs, fixtures, etc.—and unnecessarily large repair parts inventories. Such scrap is the best possible type for the manufacture of quality steel.

Q. *Isn't such material* ordinarily *turned in as scrap?*

A. Experience shows that plant "housekeeping" is not particularly good when plant production is high. People are too busy. However, if executives realized the critical situation, they would order the necessary steps to be taken.

Q. *How can I help in this drive?*

A. Appoint one top official in your plant as a Salvage Director —with full authority to give orders and throw out everything that is not going to be needed. Have him consult with your trade association's Steel Scrap Drive Committee. Call in your local scrap dealer. (Incidentally, the prices paid for scrap are the highest ever.) Promote your scrap drive by meetings of department heads and through plant bulletin boards and newspapers.

Q. *How do I benefit from moving scrap in addition to the money received for it?*

A. 1. You get the use of much-needed and expensive floor space now occupied by such equipment and material.
2. You eliminate the cost of keeping records and inventory.

Q. *When does the scrap drive* start?

A. Right this minute. The very next thing to do after reading this page, should be to start *your* plant's scrap drive!

Q. *What is the goal of this drive?*

A. One million tons of *heavy* scrap . . . and "housecleaning" in your plant will help.

PUBLIC SERVICE PROJECT · THE ADVERTISING COUNCIL

SCRAPPY SAYS:

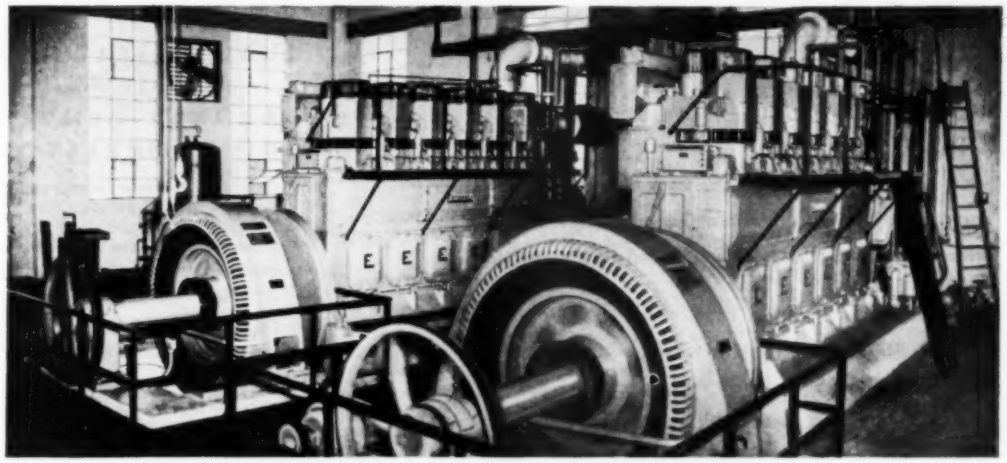
Search your plant for HEAVY SCRAP ...Help make MORE STEEL!

R. J. Wadman

Editor—DIESEL PROGRESS

FOR *REA CO-OPS*, TOO — ENTERPRISE DIESELS OFFER DEPENDABLE POWER FOR PRESENT NEEDS *PLUS* FUTURE GROWTH

A familiar sight in generating plants throughout the world, Enterprise Diesels continue to set the pace in power progress—dependably and economically fulfilling power requirements within their broad range of application. Such outstanding REA projects as the recently completed Glades Electric Cooperative at Moore Haven, Florida, is further testimony to Enterprise's story of high quality equipment doing everything demanded of it—and more. These two Enterprise DSQ-36 Diesel generating sets are daily proving their worth in supplying a higher continuous electrical output to the co-op than ever before, at comparatively low cost. Enterprise engineers —backed by 62 years of experience in the manufacture of power equipment—will welcome the opportunity of showing you how to save with Enterprise Diesels, choice of the power experts.

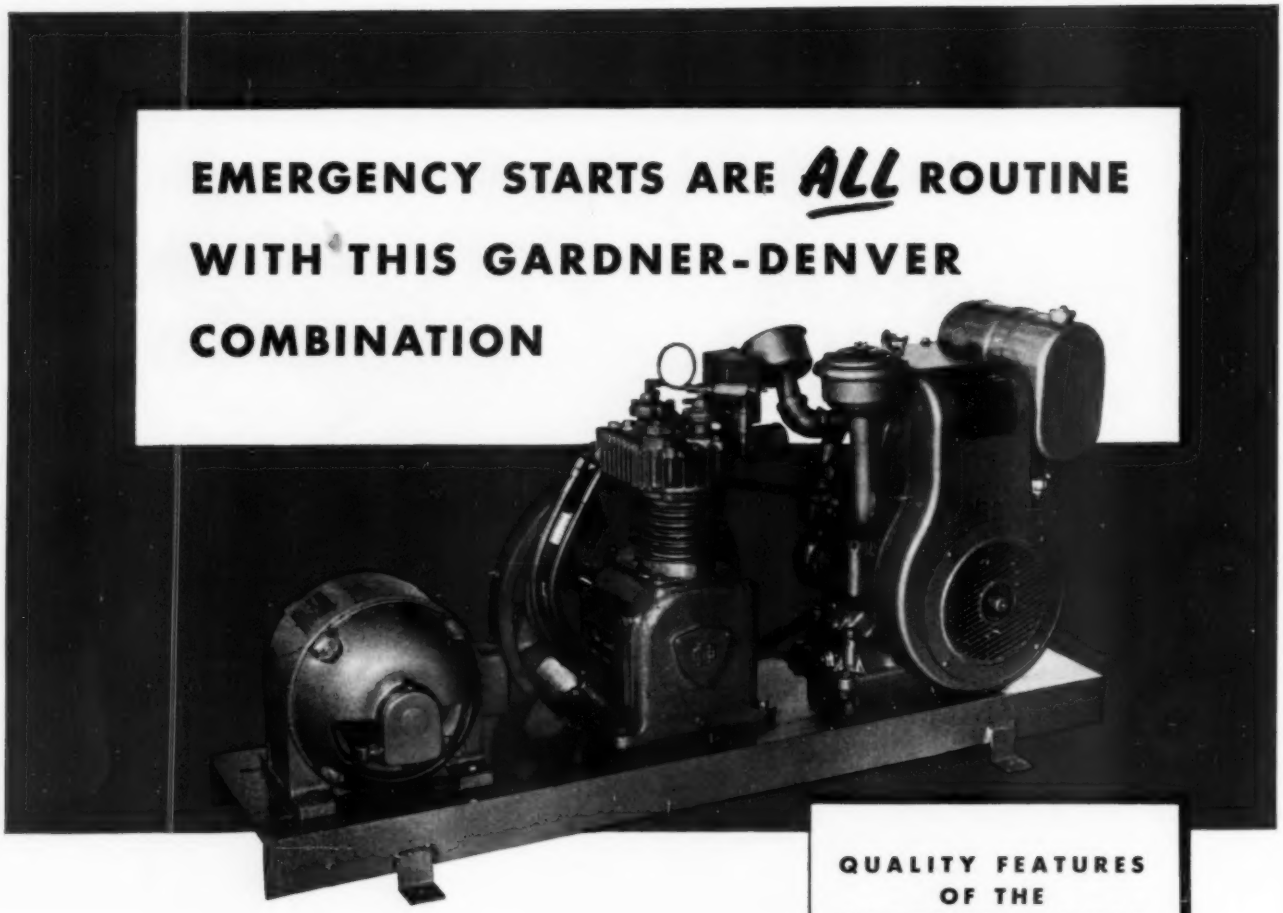


Enterprise 4-Cycle Diesel Engines and Generating Sets are available in a wide range of sizes and models up to 1800 HP per unit, tubocharged or normally aspirated. Ask for new Bulletin No. 203 for further information.

ENTERPRISE *Diesels*

ENTERPRISE ENGINE & FOUNDRY CO.
18TH & FLORIDA STS., SAN FRANCISCO 10, CALIF. *OFFICES IN PRINCIPAL CITIES*

EMERGENCY STARTS ARE *ALL* ROUTINE WITH THIS GARDNER-DENVER COMBINATION



Every start is a routine operation when your Diesel installation is equipped with a Gardner-Denver ADD Compressor that has *both* electric motor and gasoline engine drive.

With this always reliable combination drive, the Gardner-Denver ADD Compressor is ideal for the portable Diesel plant which may often be set up beyond the reach of power lines. Or, during a power failure at any location, just switch the "V"-belt from the electric motor to the dependable gasoline engine, and the ADD Compressor immediately delivers all the starting air you need.

For complete information, write Gardner-Denver Company, Quincy, Illinois.

QUALITY FEATURES OF THE GARDNER-DENVER ADD COMPRESSOR

- ★ Duplex, two-stage compression for high efficiency.
- ★ Circumferential cooling fins for greater strength and maximum cooling.
- ★ Copper finned tube intercooler for thorough heat dispersion.
- ★ Quiet plate type valves accessible in individual pockets.
- ★ Drop-forged crankshaft, counterbalanced for smooth running.
- ★ Timken tapered roller main bearings to reduce friction.
- ★ Splash lubrication system for positive lubrication.
- ★ Base mounted, with combination electric motor and gasoline engine drive.

GARDNER-DENVER SINCE 1859

SURPLUS DIESELS STILL BIG AID TO $ WISE BUYERS:

It's almost four years now since the end of World War 2 and the first release by Uncle Sam of millions of dollars worth of surplus diesel equipment.

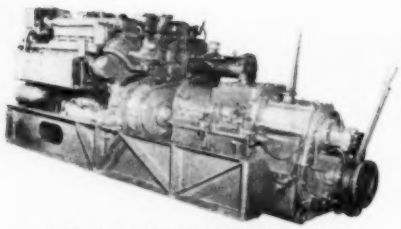
This diesel equipment, much of it never used and still in original factory crates was gobbled up quickly by alert, dollar conscious consumers and power equipment distributors.

BFM one of the largest purchasers of government surplus diesels, realized the opportunity of being able to offer to a power hungry world, diesel equipment at prices in some cases even below the actual cost of manufacture. Their stock covering some 14 acres of warehouse area converted the organization into a veritable "Supermarket for Power."

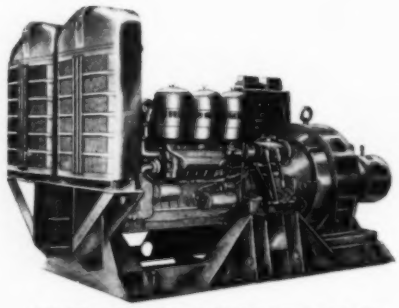
During the past four years of surplus selling and buying, millions of watts of diesel generating equipment and hundreds of thousands of diesel horse power were shipped from BFM to $ wise buyers in every corner of the globe.

In order to cope with the problem of re-constructing and adapting surplus diesels to peacetime use, BFM carried on a widespread expansion program in their shops. Diesel, electrical and machine shops were expanded to handle the steady flow of diesels. During 1947-8 alone these shops processed over 200,000,000 watts of generating equipment and 1/4 million horse power in prime movers. Tank engines were converted into marine and industrial units . . . marine engines were converted into power units and generating sets . . . Everything, in some cases the impossible, was done to enable industrial purchasing men to avail themselves of the low prices of government surplus diesels.

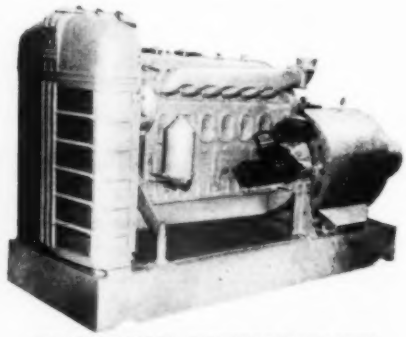
The curtain hasn't quite come down on the surplus diesel picture. There's still a wonderful stock of fine equipment available to $ wise buyers . . . there's still a supermarket full of famous name diesels at BFM, the "Supermarket for Power."



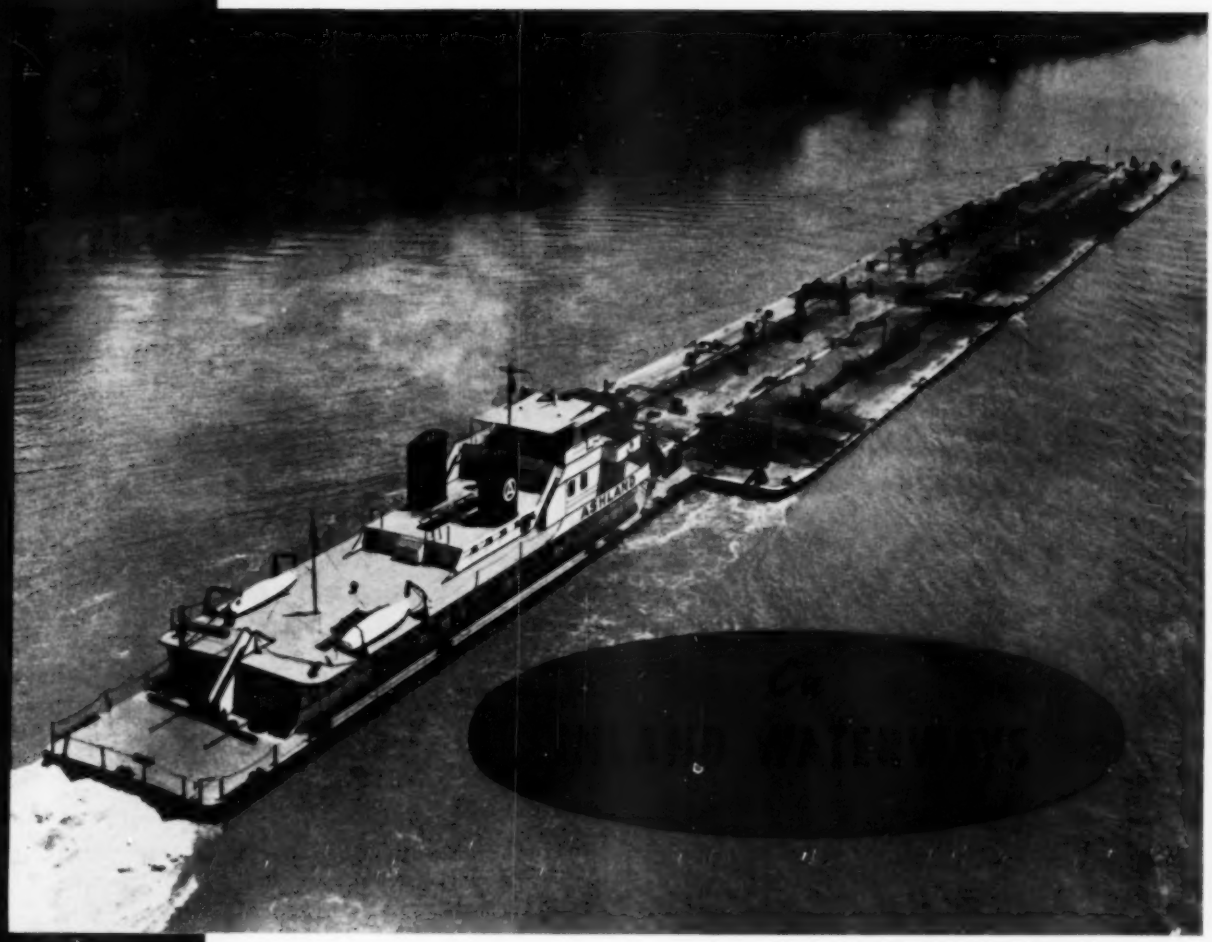
330 H.P. TWIN MARINE DIESEL



150 KW DIESEL GENERATING SET



75 KW DIESEL GENERATING SET



ONE OF MANY TOWBOAT INSTALLATIONS WITH ENGINES REGULATED BY

Marquette HYDRAULIC GOVERNORS

The **Marquette METAL PRODUCTS CO.**

CLEVELAND 10, OHIO

SUBSIDIARY OF CURTISS-WRIGHT CORPORATION

Also Manufacturers of: ROLLER BEARING TEXTILE SPINDLES
WINDSHIELD WIPERS FOR AIRCRAFT, TRUCKS AND BUSES • FUEL OIL PUMPS
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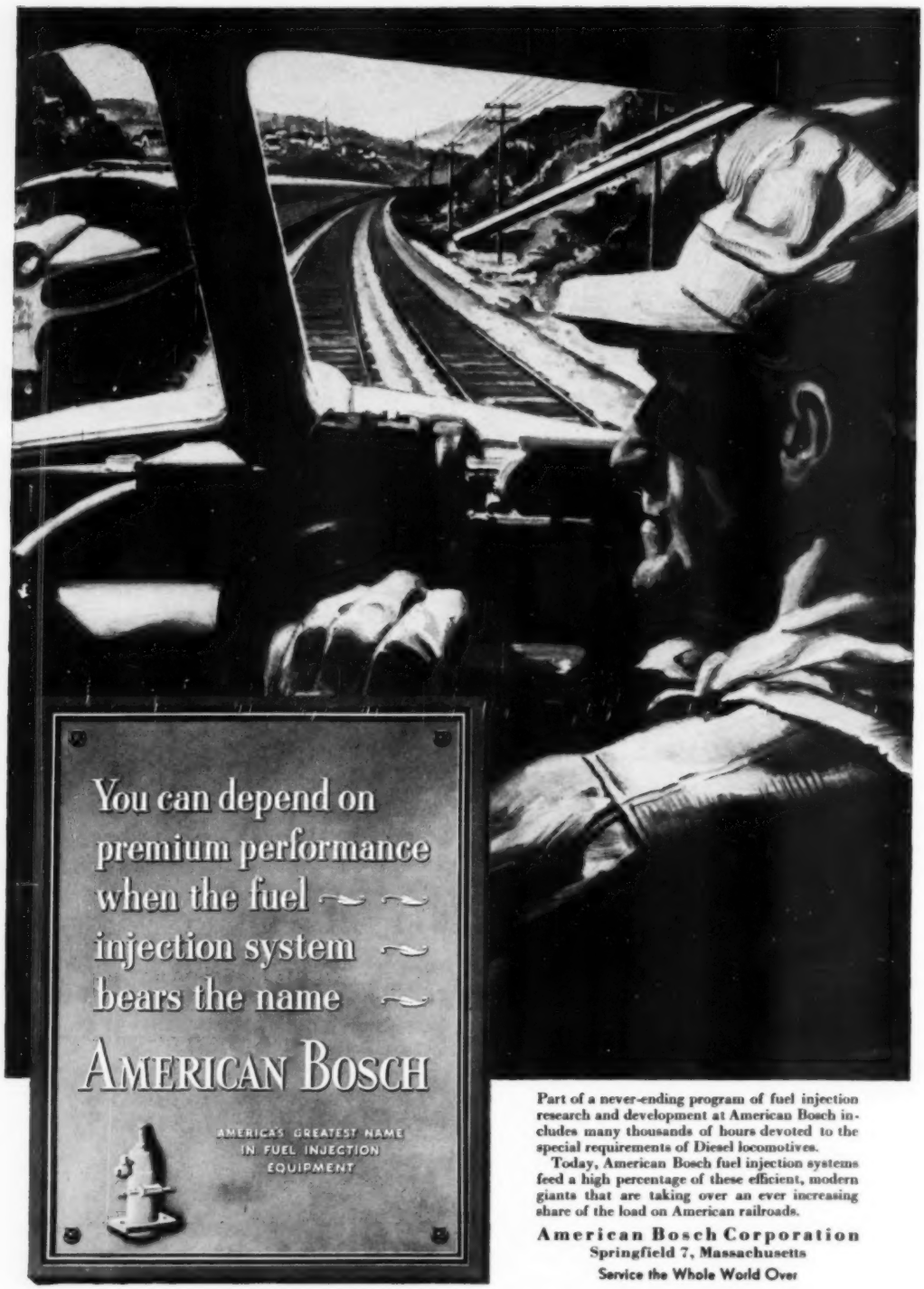

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CONTENTS FOR MARCH, 1949

FRONT COVER ILLUSTRATION:

Near Andersonville, Georgia, this Caterpillar diesel tractor with scraper is stripping overburden, consisting of over 5000 cu. yds. of sand, muck and chalk, for the American Cyanamid Company.

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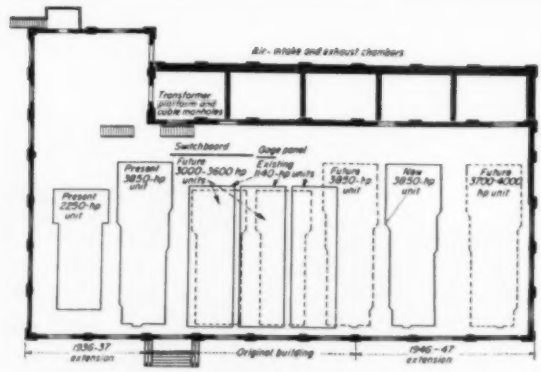
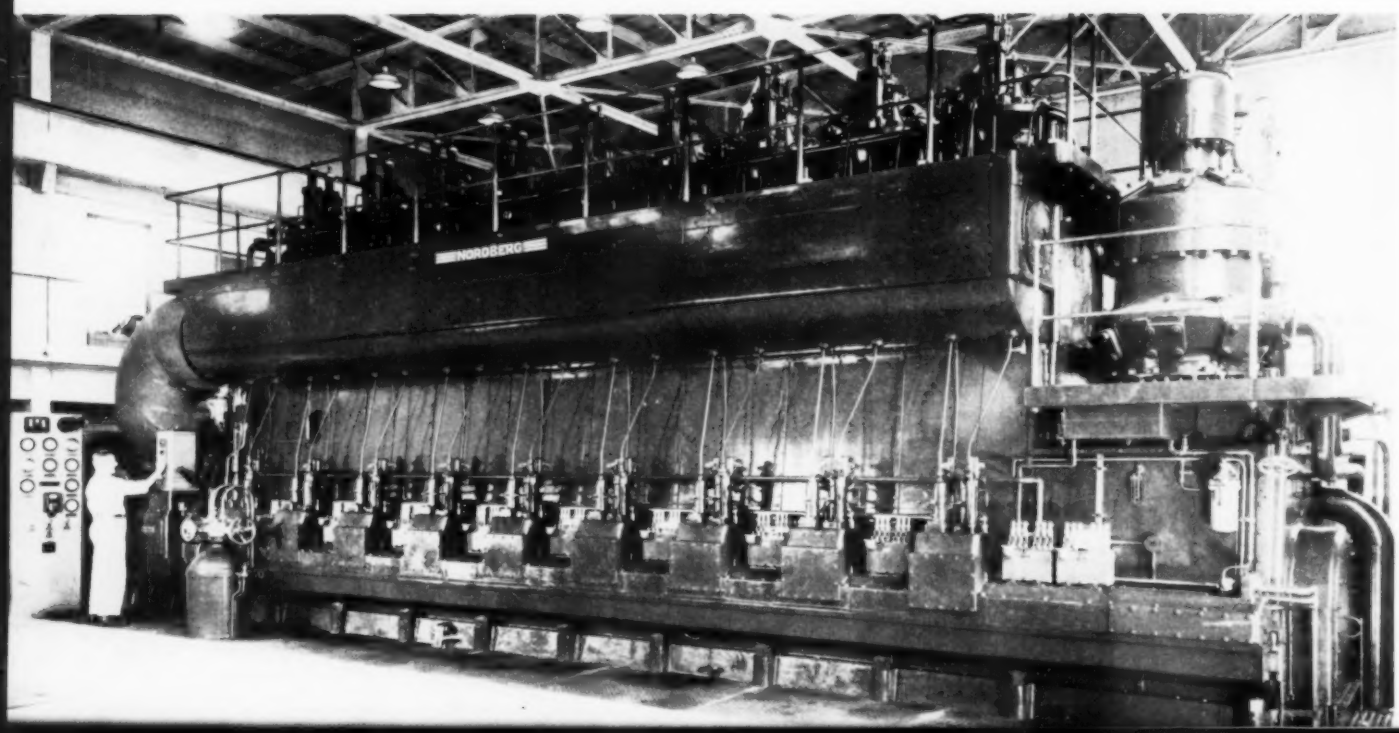
Engine room floor plan showing how it is planned to replace three 1140 hp. units with two 3000-3600 hp. units and have room for 2 more large units.



Building which houses the deisel plant at Grand Haven, Michigan.

GRAND HAVEN, MICHIGAN

By J. BRYAN SIMS*



THE Board of Public Works, operating the Municipal Power System of the City of Grand Haven, Michigan, has recently completed the third section of its diesel plant which brings its total horsepower to 13,370, and provides ample space for an additional unit of approximately 4,000 hp. The Board operates an older steam turbine plant as standby, and the decision to increase the diesel capacity was based upon a study made which considered both steam and diesel expansion possibilities in the plant.

Grand Haven is a manufacturing and resort town on the east shore of Lake Michigan, and has operated a municipal plant since 1896. The usual experience of small municipal generating plants progressing from reciprocating steam engines to turbines was Grand Haven's, but in 1929, due to high operating costs of the 150 psi. turbine and boiler plant of 3,000 kw. capacity, it was decided to add two 1140 hp., 800 kw. Baldwin-De LaVergne, 4 cycle diesel engines connected to 2400 volt, 3 phase Elliott generators. This addition was completed in 1931, and a third and similar unit was added in 1934.

The electric load growth continued and the economy of the diesels caused another building extension to be built in 1937 at which time a 2250 hp., 6 cylinder, mechanical injection, 21 in. x 29 in., 225 rpm., 1600 kw., 2 cycle Nordberg diesel connection to an Elliott 2400 volt, 3 phase generator was installed. Sufficient space was provided for still another unit, and in 1941 an air injection, 3850 hp., 9 cylinder, 21½ in. x 31 in., 2715 kw., 2 cycle Nordberg diesel connected to a 7200 volt, Allis-Chalmers generator was installed complete with a Foster Wheeler waste heat boiler. Due to the increased usage of electricity by residential customers and more particularly by industrial customers, whose sole source of power is the municipal system, the power plant has continued to grow rapidly. Manufacturing plants in the community produce such diversified products as pianos, engines, automobile mufflers, leather, novelties, pneumatic tools, gloves, refrigerator cabinets, soda fountains, ice cream freezers, radio cabinets and many others.

Since installing the first diesel, firm capacity of the diesel plant (full load with largest unit out of service) has not been adequate to meet peak demand, and so the steam plant has been maintained as standby. This proves expensive in fuel and labor, since the arrangement of the two plants with passageway between the two buildings does not lend itself to allowing the diesel operators to attend the steam plant as conveniently as might be desired.

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* *Superintendent, Board of Public Works, Grand Haven, Michigan.*

Before making the newest extension in 1946 a long range study was made which considered extending and modernizing the steam plant. The nature and size of the load was against economical steam operation. Present electric loads run from a peak of about 7000 kw. to 11:30 A.M. down to 1000-1500 kw. at night, as the majority of the factories do not operate with night shifts. Therefore, it was decided to continue diesel generation using heavy residue fuel from nearby refineries, and the third extension to the diesel plant was built. This meant rearranging intake and exhaust facilities for the three older 4 cycle engines. These intake filters and exhaust silencers had been located at the south side of the building where it was desired to extend the building. The intakes for these engines were moved and air taken through louvres under the windows in the front of the building. A small filter room was built into an existing recess in the foundation. The exhaust silencers were moved to the rear of the building, and the new extension was built after tearing down the older one-story intake and exhaust building. The plant was extended with space sufficient to house a new air injection 3850 hp., 2715 kw., 225 rpm., 9 cylinder, 21½ in. x 31 in. Nordberg diesel unit direct connected to a 7200 volt, 3 phase Elliott generator, and to provide space for an additional unit of this capacity or larger.

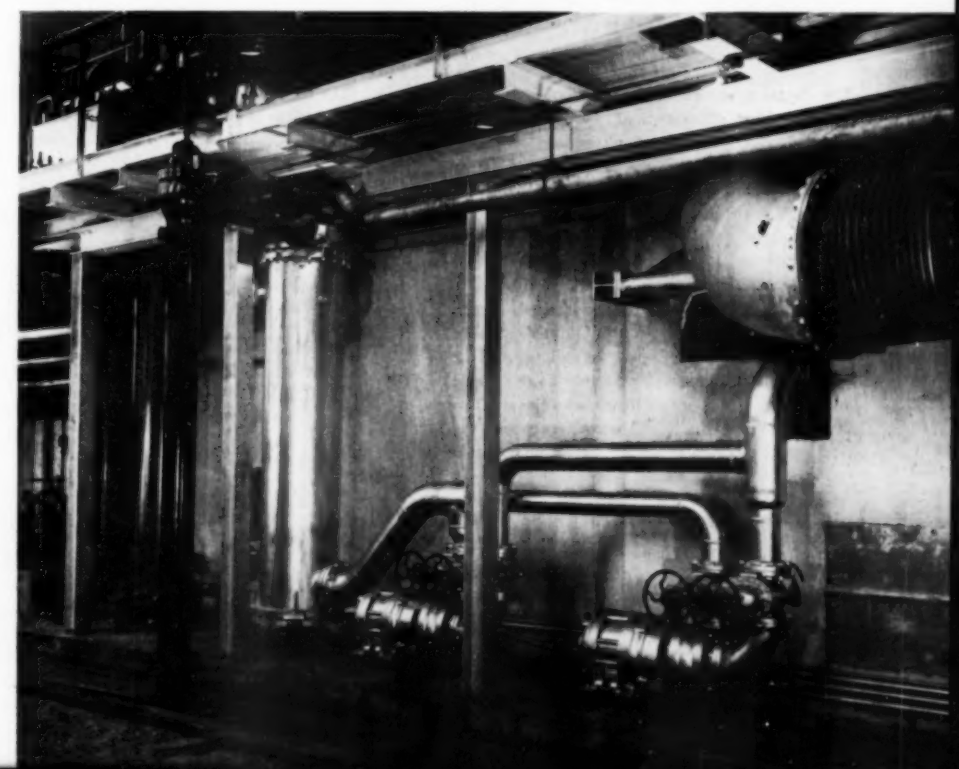
In selecting the new unit, consideration was given to the possibility of purchasing a larger bore, possibly even a larger double acting engine. However, in view of the advantages of having all units of approximately the same size and as nearly alike as possible for interchangeability of parts etc., the 21½ in. engine was selected.

Prior to 1941, utilization of waste heat had not been considered, but at that time a Foster Wheeler 1836 sq. ft., 150 psi., extended surface waste heat boiler was installed. The latest unit included a similar boiler and also a Maxim exhaust and intake silencer. Two Struthers-Wells oil coolers were used, and a jacket water heat exchanger of the same make. The soft water circulating pumps were Allis-Chalmers 965 gpm. capacity, one used continuously and one for standby. A Blackmer auxiliary lubricating oil pump is used for starting and stopping the engine, and the screen of a Dollinger Staynew automatic air filter travels through an oil bath to keep the intake air clean. This air cleaner is equipped with low pressure air to blow excess impingement oil off the screen.

The new building extension is 54 ft. x 57½ ft. (Craneway), with an additional 25 ft. 3 in. extension at the rear to house the waste heat boiler and muffler room, air intake silencer and filter rooms at the basement and operating floor level. Additional space above provides a locker and wash room, chief operator's office and an entrance foyer. A balcony at crane level provides space for cooling water surge tanks, 250 psi. air starting tanks, day fuel tanks, etc. Water softening for jacket water make-up is accomplished by using the steam plant's Zeolite water softeners.

Raw cooling water for the five engines totaling 13,370 hp., and the steam turbine plant is taken from an underground water intake pump house on Grand River located in front of the plant. A new 2000 gpm. vertical, shallow well type pump of Fairbanks-Morse manufacture has been installed to supplement several Peerless 1000 gpm. pumps of the same type. The raw water line from the pump house to the engines coming across the street underground is 12 in. cast iron, and an additional line of the same size is planned for the future.

Unfavorable experience with inaccessability of previously installed waste heat boiler and air intake filter rooms, led us to redesign this area in the new addition. As shown by the drawing, operators have ready access to these rooms from oper-



Struthers-Wells coolers and Allis-Chalmers jacket water circulating pumps in the basement. Piping color scheme is: Soft water, aluminum; Raw water, Green; Fuel Oil, Black; Lube Oil, Tan; Air, red.

The new Nordberg 3850 hp. diesel direct connected to Elliott 2715 kw. generator. Fuel injection pumps are American-Bosch, lubricators are Manzel.

Close-up view of starting end of new 3850 hp. Nordberg, left to right, J. Bryan Sims, Supt., Grand Haven Board of Public Works; John Iglauer, Secy-Treas. Michigan Municipal Utilities Association; and Roy R. Robinson, Manager Niles, Mich. Board of Public Works.

ating floors. Doors from the boiler and muffler rooms into each section of the air intake filter room allow warm air to enter and prevent snow entrainment with resulting icing of the filter screens which had been experienced in the past. Hoal's louvres, similar to those used to revamp the 4 cycle engine intakes, were used on the outside. These also help prevent entrainment of snow and rain.

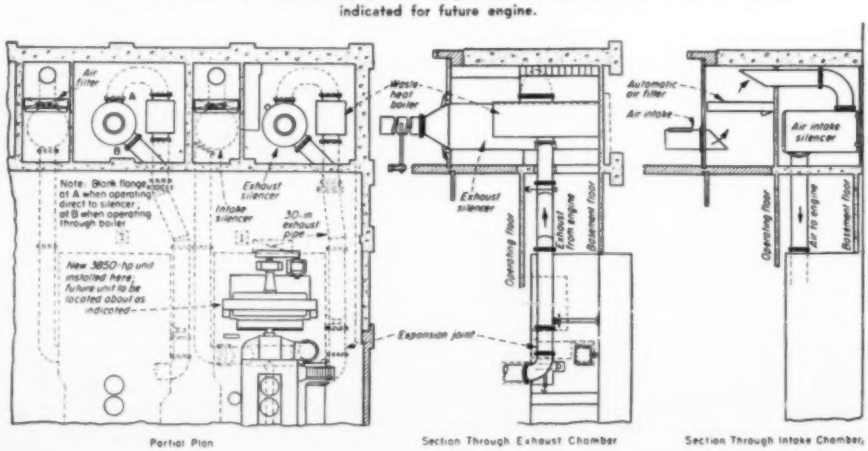
The electrical section of the installation is interesting, in that generation of the last two units installed is at 7200 volts, 3 phase, and generator oil circuit breakers are outside the building in a steel outdoor switch structure. The 7200 volt generator bus is also in the structure. The older, smaller diesel units generate at 2400 volts with indoor bus and oil circuit breakers, and the two sets of generators operate in parallel through a bank of 2500 kva., 7200-2400 volt transformers, located in an outdoor steel substation. Operation is not particularly difficult, as all control is handled at the switchboard using the same synchroscope. A 7200 volt loop circles the city furnishing power to industrial users, and across the river on 175 ft. steel towers to the adjoining town of Ferrysburg. Most of the local residential feeders are 2400 volt. The generator switch panels were assembled and wired in the plant, and steel cubicles of our own design located in the basement near the generators house current and potential transformers, lightning arresters, capacitors, etc. Generators and generator cables are protected by differential relays of General Electric manufacture. All switchboard instruments and voltage regulator are from General Electric Co.

We have available from local Michigan refineries straight run residual fuel oil with a viscosity of from 500 to 1000 SSU @ 100° F., and fire and flash range from 300° F. to 450° F. The fuel carries a considerable amount of wax. Two largest size Sharples centrifuges, operating simultaneously and continuously, remove water, sediment and wax. The oil is pre-heated to approximately 100° F., it having been found that this is the best temperature at which to pre-heat it for satisfactory centrifuging. The fuel then goes through a large Nugent filter and into conical bottom settling tanks where it is further heated with waste heat steam. Before going to the engines, it again goes through individual Nugent filters on each engine. We burn from 7000 to 8000 gal. of this fuel per day. Our total storage is 770,000 gal., with one 420,000 gal. tank above ground, and 350,000 gal. of storage in three tanks buried in the sand near the plant. These tanks were especially designed by us with annular angle iron stiffening rings inside to carry the sand load, and are heated with waste heat steam. There is also an 8,000 gal., 3-compartment lubricating oil storage tank. Considerable study has been made of the handling and burning of the heavy fuel which has a pour point as high as 42-45° F. All fuel piping is insulated, and soil heating cable runs parallel with piping to heat the oil in an emergency. Engines are shut down and started with lighter distillate. Complete oil testing equipment is available for the city chemist to analyze either fuel or lubricating oil, and oil is purchased on specifications.

After installing the next unit, as provided for in the building extension, further expansion has been considered by replacing the older 4 cycle engines with larger 2 cycle units as shown on the plan. This would permit increasing the total plant horsepower to 23,400 or more. These older engines are giving good service, and what is done will depend upon future load conditions and the fuel market.

The Grand Haven electric power system is operated separately from other city activities by a board of five local business men elected by the voters. They serve five year staggered terms. Separate accounting gives an accurate record of all operations. For example, the Electric Board pays the city $3,600 per year rent for offices occupied in the City Hall. They also pay voluntary city and school taxes, and as a special contribution have recently completed the payment of $45,000 worth of bonds on the municipal hospital. The power system has been particularly active in assisting in the attracting of small manufacturing concerns to the community. All engineering and construction of the last two extensions was done by the system's own organization.

Layout of air intake and exhaust systems for the present 3850 hp. Nordberg diesel with hookup indicated for future engine.



DIESEL "DRIFTMASTER" . . . A MODERN CATAMARAN

By WILL H. FULLERTON

THE Wills-Spedden Shipyard, Inc., Baltimore, Md., has recently delivered to the U. S. Army Engineer Corps, a twin-screw, catamaran type diesel vessel *Driftmaster*. The contract was awarded to the Wills-Spedden Yard on February 12, 1948, the keel was laid on May 10, 1948, the launching occurred on September 25, 1948 and the vessel was delivered to Caven Point in New York Harbor on January 8, 1949.

The twin-hull *Driftmaster* has an overall length of 99 ft. 1⅛ in.; beam moulded (over both hulls) 36 ft.; depth moulded (amidships) 10 ft. and a designed loaded draft of 6 ft. The vessel has a displacement of 266 tons.

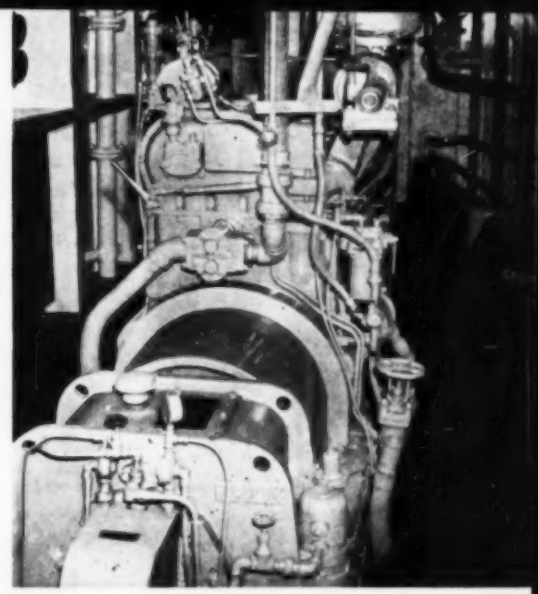
The *Driftmaster* was designed exclusively for the collection of driftwood and debris in New York Harbor. Two removable chain nets are carried between the hulls. One net used at a time for collecting the debris while the vessel is under way. The nets are raised to a position clear of the water by means of an electric winch operating through reduction gears. From the raised position, the nets are lifted from the net wells by means of a 12½ ton boom which is topped from an "A" type derrick frame 55 ft. above the main deck, which forms an integral part of the *Driftmaster*. The nets are discharged on to an incinerator barge for the disposal of the debris.

There is a main engine room in each hull and propulsion is obtained from one Model 6-278A, 300 hp. General Motors diesel engine mounted in each hull which drives a 54 in. diameter by 40 in. pitch, three-bladed bronze propeller through a 4½ in. shaft. The shafts are furnished with monel liners and are supported by Cutless-Rubber Bearings in the stern tubes and struts. The main engines are equipped with air motors for starting.

Ahead and astern direction and speed is controlled from the pilot house through an air operated clutch. This pilot house control, together with the twin-rudders make the *Driftmaster* an exceedingly maneuverable craft.

An auxiliary engine room is located in the main deck house. Electrical power is derived from one (1) 40 kw., 125 volt, direct-current generator driven by a Buda diesel engine, both units being battery started. The vessel is also equipped with a dead front switchboard, hoisting winch, motor-generator set for shore power and a heating boiler all of which are located in the auxiliary engine room; together with salt and fresh water pressure sets, air compressors, air tanks, heat exchangers, fuel oil transfer pump, fire pump and carbon dioxide fire protection which are located in the main engine rooms.

In the pilot house, located on the bridge deck,



One of two GM 300 hp. diesel propulsion engines installed in each side of the twin-hulled vessel.

are air gauges and tachometers for the pilot house control of both engines, ship-to-shore telephone, chart table, settee, additional alarm panel for the diesel engines and tell-tale panel for the running lights. The vessel is equipped with a nine-person metallic liefboat and is U. S. Coast Guard approved. There are no sleeping quarters on the vessel, but it is equipped with a mess room and toilet and shower spaces.

On the bay trials, the *Driftmaster* attained a top speed of 7.69 knots with 300 hp. per engine at 1200 rpm., the propeller speed through the reduction gear being 405 rpm.

The *Driftmaster* is a unique solution to the drift problem in New York Harbor with its 770 miles of shore line, 350 miles of which is occupied by piers and bulkheads. All sorts of debris menaces shipping. They have found a grand piano, rope reels, ladders, garage doors, railroad ties, etc., etc. Currents are studied and charted to determine the probable gathering places of floating material.

In other words they know where drift collects and they go to those spots to scoop it up in the nets of this modern catamaran.

Bow view showing the catamaran arrangement of the twin-hull "Driftmaster" with the forward net in position to catch drift.

Fig. 1. Before tests were started all pistons were removed and replaced in this condition.

Fig. 2. At the end of 1000 hrs., No. 1 piston from engine using parafinic lube had hard deposit above top ring.

Fig. 3. Piston No. 1 from engine using napthenic lube had little deposit at end of 1000 hrs.

OPERATING AND MAINTENANCE PROBLEMS WITH ENGINES USING SOUR GAS FUEL

By C. P. AMBLER*

THIS is a history of an investigation into the factors and conditions which have a direct bearing on the efficient operation and maintenance of gas engines. Prompted by the urgent need for maximum production, and the highest possible engine service factor, the investigation was organized in 1944 when several engines began to show signs of trouble, and has continued without interruption since that time, is still in progress.

The first group to come under observation consisted of fifteen 300 H.P. gas engines. The general scope of enquiry, however, was rapidly expanded until thirty-nine engines were involved, and the system of checking and testing, which has ben specialy set up, was absorbed into the general routine of preventive maintenance.

The engines under observation are all four cycle, angle type engine compressors, operating at 350 R.P.M., and the majority are used in refrigeration services. They were all newly installed in 1943. Every possible precaution was taken, previous to subjecting the engines to general service, to establish good bearing and cylinder wall surfaces. The manufacturer's recommendations for initial starting and running new machines were carried out. In addition, all machines were operated under very close supervision for a minimum period of 200 hours without load and at reduced speed.

Three engines first attracted attention when excessive cylinder wear was discovered after 4,500 hours of operation. At this time the worst condition disclosed a rate of wear at the top of the cylinder of over .0006" per thousand hours operation. This was twelve times the normal rate to be expected from this type of machine. The rate of wear was not by any means constant, but varied between batteries of engines in different compressor services, although the developed horsepower and general service factors were practically the same for all three groups.

One hundred and twenty cylinders were examined and found to be all alike in one respect only. This was that the most severe wear had taken place at the top of the cylinder bore for a distance of not more than 2" down the stroke. All cylinder dimensions below this point were closer to normal. There was no sign of cylinder wall scoring. This general condition indicated that the high wear rate *could* be due to corrosion developed during combustion.

It was recognized that the fuel gas was of uncertain and fluctuating quality; this would be a separate study. The fact that all engines in any one group, while not consistent in wear rate, were more closely comparable to each other than to engines from other groups, suggested that the material handled in the compressor end of the machine may have an influence on power cylinder wear. The three gasses which are under compression were dry ammonia vapour, ethylene and methyl chloride.

As a first step, air is taken in through individual filters to each engine for combustion was checked. This revealed the fact that air supplied to the three engines on methyl chloride service was at times contaminated by methyl chloride vapour.

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These three machines had a wear rate of .006" per thousand hours operation. The air intakes were moved to a cleaner atmosphere and a second set of cylinder dimensions was taken after a run of 3,400 hours. During this run the wear rate had improved to .0035" per thousand hours operation. At this time a total of 32 engines were brought into the investigation. These varied from 300 to 850 H.P. each, and were divided into six separate batteries, on four distinct types of compression service.

Maintenance methods were organized on a preventive rather than corrective basis. Machines were taken down for overhauling at prescribed time intervals and not by general performance diagnosis. Various tests were inaugurated, in an attempt to discover a sound and reliable method of predicting engine conditions, in order to avoid unexpected repair work. A filing system was set up, which gave a clear history of every machine. The hours of operation oil consumption, and observations on performance were recorded. In addition, routine work was put on a regular schedule and recorded. Engines were overhauled at 5,000-hour intervals, and at each overhaul a special report including all measurements was issued. For instance, one of the regular tests was power cylinder compression pressures. These were recorded every 1,000 hours in the expectation that a gradual drop in pressure would indicate piston ring and power valve condition.

Fuel gas quality was considered as a major problem. H_2S was present occasionally in concentrations as high as 100 grains per 100 cubic feet of fuel. No satisfactory figure for H_2S tolerance could be established, but it was obvious that the contamination must be kept down to an absolute minimum if a reasonable cylinder life was expected. There was reason to believe that even under the best possible conditions of operation of the gas treating system, some variation in gas quality could be expected. Any upset would permit a high concentration of H_2S, and even though such upsets might be of very short duration, the residual effect on the engine due to the contamination of the oil could seriously affect the entire machine.

It is generally recognized that cylinder wall temperatures affect cylinder wear. This was not regarded as a factor in this investigation, as all machines operated under a closely controlled jacket temperature of 160 degrees Fahrenheit on a closed circulation system, so that even when any engine was out of service the jackets were always almost up to normal temperature. Under these conditions there did not appear to be any serious risk of cylinder wall condensation and consequent carbon dioxide absorption during starting up periods.

It was also recognized that fuel valve settings might have an influence on cylinder wear when corrosive compounds are present; a lean mixture could give a higher stimulation to corrosive elements in the products of combustion. To eliminate this factor, fuel valves were set to maximum manifold depression at normal engine speeds. This gave a slightly rich mixture, showing just over 1% C.O. in the exhaust gases.

The investigation disclosed that in spite of double piston rod glands and an open space between the compressor cylinder and the scraper rings at the crosshead chamber, contaminating compressor vapours found their way into the engine crankcases, probably in minute quantities absorbed in the oil film on the rod surface, but over a period of constant operation the crankcase concentration built up to astonishing levels. A series of samples of crankcase vapours taken from engines in different groups disclosed that, without exception, the engines showing the greatest power cylinder wear also had high contamination of crankcase vapours.

Steps were taken to test out the effectiveness of forced air ventilation of crankcases to remove corrosive vapours. The air was introduced under a light pressure at one end of the crankcase and drawn away by induced draft at the other end. The first test disclosed an immediate drop in methyl chloride concentration from 470 P.P.M. to less than 30 P.P.M. It was discovered, however, that this result could not be counted on as constant and stable.

Forced air circulation would undoubtedly remove corrosive vapours if properly applied, but air introduced into a hot crankcase will cause rapid oxidation of the lubricating oil, with consequent sludging and general breakdown. Under these circumstances modified crankcase ventilation was accepted as a step in the right direction.

Hot lubricating oil circulating in a crankcase cannot fail to absorb the vapour with which it is in direct contact, and in splash fed cylinders the crankcase oil will be taken to the top of the cylinders during the normal lubricating process. Subjected to the temperature of combustion, the absorbed crankcase vapour will be released, and if corrosive will add another factor to possible causes of cylinder wear.

The first 5,000-hour overhaul disclosed a fairly constant condition in all machines. In spite of closely controlled temperatures, there was a moderate deposit of sludge in the crankcases, but lacquer deposition was not significant and all bearings were in good condition. Almost without exception, however, piston rings were heavily coated with a hard carbon deposit, and the top compression ring was generally found to be seized in its groove. There was also a heavy carbon deposit on the piston face above the top ring, and the lower rings including oil scrapers, were clogged with gum, which interfered with ring action. This condition introduced the question of cylinder wear due to abrasion. Although there was no sign of cylinder scoring, there was, however, some discoloration of the cylinder walls.

Piston ring seizure is generally caused by partial burning of fuel or lubricant. However, the en-

Fig. 4. Piston No. 2 after 2000 hrs. operation with paraffinic lube.

Fig. 5. Piston No. 2 after 2000 hrs. operation with naphthenic lube.

gines under investigation used dry vapour fuel and not liquid fuel. Therefore carbon deposition was more likely to come from lubricating oil which is subjected to the high temperatures of combustion.

Control of crankcase oil quality by means of complete laboratory inspections was already an established practice. Samples of oil were taken from each engine in service at intervals of 300 to 500 hours, and neutralization number was regarded as the first significant factor. Oil was discarded and the engine taken out of service for crankcase flushing when the neutralization number reached .7. It is not possible to overemphasize the importance of lubricant control. It is equally important to realize that the methods, equipment and type of oil used are matters for the closest possible study of all the local conditions under which the engines will operate.

Fig. 6. No. 3 piston after 4000 hrs. operation on napthenic oil.

Fig. 7. No. 3 piston after 4000 hrs. operation on paraffinic lube.

The investigation now resolved itself into a threefold problem. There was the pressing problem of excessive cylinder wear. There was, in addition, the problem of poor performance of piston rings, and finally, the uncertainty of oil stability. Lubrication was given priority as a factor which would be most likely to affect all three conditions, and an experimental program was set up to explore all possibilities along this line. The engine lubrication systems are the conventional pump fed pressure type, feeding oil to all bearings at 40 lbs. p.s.i.g. A waste-packed filter was installed on a bypas stream for oil filtering.

It is the engineer's duty to interpret the behavior and response of his machines to intelligent tests, and select a lubricant on the basis of actual practical performance. There is a very wide choice and the field has been greatly increased in recent years by the introduction of additive type oils. Additives can be broadly classified into two categories: inhibitors for retarding oxidation, and detergents of several types to prevent precipitation of sludge and carbon by holding these materials in suspension.

It is recognized that the power of an inhibited and detergent oil to hold oxidation and colloidal products in suspension will depend on the amount and activity of the original compounding, and as the length of time in service is increased, the quantity of sludge and carbon in suspension will increase to the point of saturation, beyond which there is no further detergent power, and these foreign materials will be precipitated.

With these facts in mind a detergent oil was put on test. As anticipated, there was an improvement in the internal cleanliness of the engine. However, the service factor on the filter was decreased and the life of the oil was short. It was quite evident that in the test in question on a large industrial engine, detergent oils were not economically feasible.

The writer has no wish to create any impression that there is a prejudice against this type of lubricant. On the contrary, detergent oils are a proven success in keeping piston rings free, by dispersing carbon and preventing its formation in the piston grooves. In cases where the volume of oil in circulation is comparatively small, and where adequate filters and coolers cannot be accommodated, detergent oils may be the only possible lubricant.

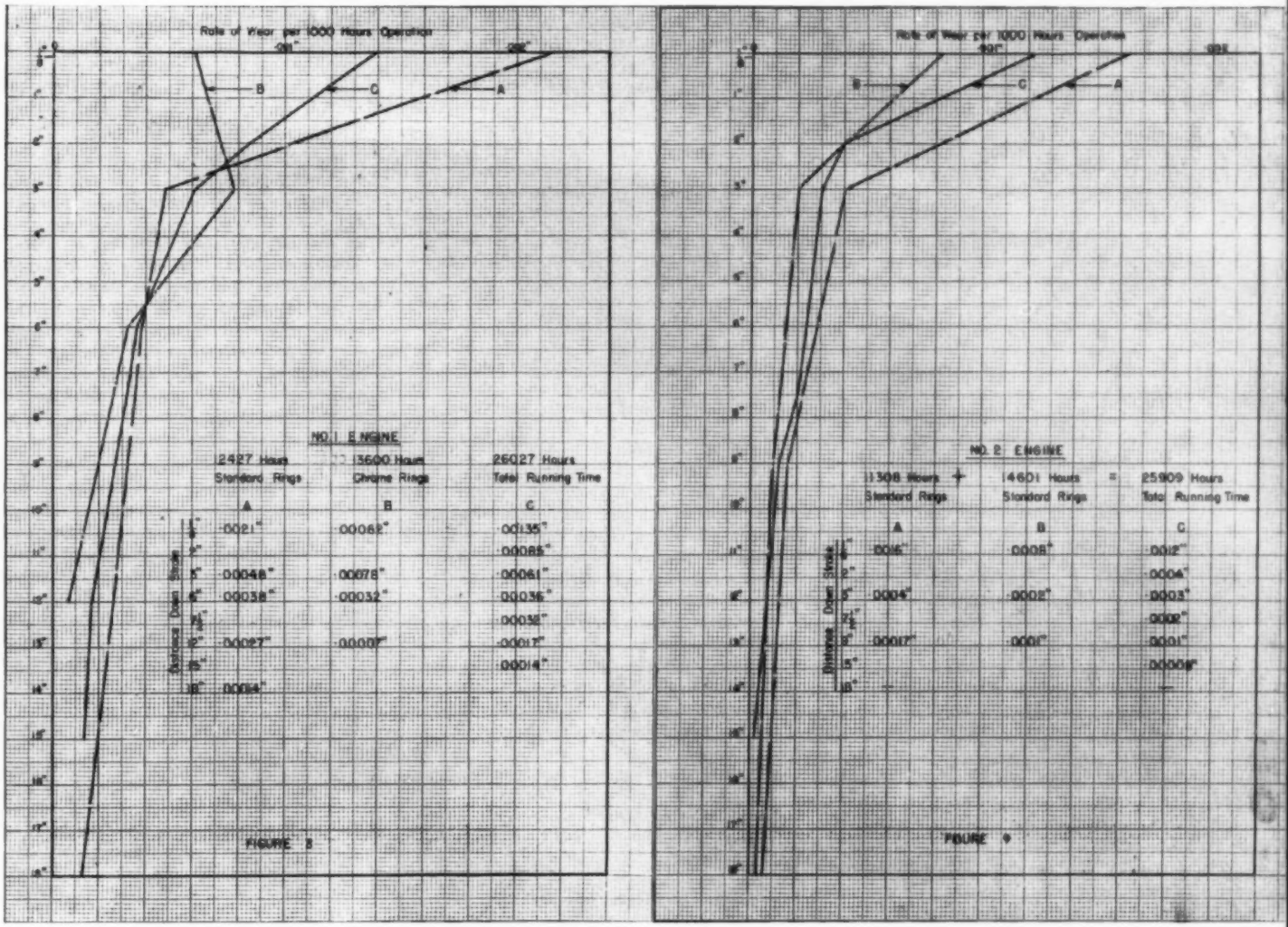
In the cases under investigation, it was felt that a straight mineral oil was the most feasible on economic grounds. For this same reason, however, some improvement in methods of filtering would be necessary in order to maintain closer and more definite control.

The body of the clarifier should be constructed to withstand the maximum oil pressure to be encountered, and the filtering material should have characteristics that would permit efficient clarification at normal engine temperatures, although in many cases a separately heated clarifier is a definite advantage. There was clear evidence that rapid flow rates through the filter gave better results than slow percolation. If the cartridge is cylindrical the direction of flow should be from the outside of the cartridge in towards the center to eliminate the risk of channeling, and at the same time present the greatest possible cartridge surface to the incoming oil for a given volume of filter material. This permits a high flow rate in ratio to the weight of charged material. Tests on a number of clarifiers conforming closely to these specifications proved beyond a doubt that without exception the operation could be stabilized as far as lubrication was concerned. The characteristics of the oil were brought under flexible control, and this was confirmed by definite experiments. In a typical case the neutralization number of the crankcase oil was allowed to rise to a value of 1.2 with the clarifier out of service, and within twenty-four hours after putting the clarifier back into the circuit the neutralization number dropped to .13. This test was carried out under severe operating conditions of the oil.

Crankcase oil changes were eliminated and the need for laboratory inspections was considerably less frequent. With further experience it was found possible to forecast the life of filter charges quite accurately. In this connection it is worthy of note that the interval between new charges varied over a fairly wide range even between engines in the same group.

The statement is sometimes made that clarifiers are automatic, in the sense that they will not pass dirty oil and will, in fact, cease to operate when the charge is contaminated. This is true, but capacity tests have proved that the clarifier efficiency drops long before the charge is completely clogged with foreign material. To quote actual figures in the case of a clarifier operating at a constant pressure of 40 lbs. and a temperature of 150 deg. F., this ceased to pass oil after 1,000 hours in service. The charge kept the oil clear and sparkling for 500 hours, and between 500 and 700 hours there was a gradual and steady deterioration in colour. After 700 hours the oil was opaque. The rate of flow was reasonably constant up to 500 hours, but had been reduced to one-third of the original rate at 700 hours. Under these conditions sludge would be developed faster than the clarifier could remove it from the oil, and at 1,000 hours there was some deposition on the internal surfaces of the engine, although it is interesting to note that the neutralization number of the oil was still constant. A new filter charge picked up the deposited charge, which was to be expected.

The color of an oil has little bearing on its lubricating qualities unless discoloration is due to foreign abrasive material in suspension, but color standards can be developed as a useful guide to clarifier performance.



Figs. 8 & 9 are typical graphs showing the rate of cylinder wear under varying conditions in identical engines. Lines A, B, and C are fully explained in the text.

The improvement in oil quality control was reflected in a very general improvement in internal sludge, but this shortened the life of the second engine conditions, crankcase chambers were clean and free from all sludge, and there was also some improvement in the condition of all piston rings, but this was not enough to be regarded as significant, or an assurance that operating hours between overhauls could be sensibly extended. Carbon deposition was still heavy, although piston rings showed less tendency to seize in the grooves.

The improvement in general conditions and the ease of quality control encouraged further development, to explore the possibilities of using other grades of oil. The oil in use was a paraffin base and had the following characteristics:

Viscosity	at	210°F.	64–66 Secs.
"	"	145°F.	170 Secs.
"	"	100°F.	537 Secs.
Flash Point		460°	
Pour Point		25°F.	
Carbon Residue		.05	

As a first test, the oil selected was also paraffin base, with almost the same characteristics as the original oil. The viscosity at normal engine oil temperatures of 145 deg. was the same in both instances, although carbon residue was higher. There was also some difference in the methods of refining, but it was felt that the clarifiers could compensate for all the apparent differences between the two oils.

The tests fully justified this line of reasoning and its success prompted further investigation into the possibility of not only changing the grade of oil, but also using an oil of entirely different properties, with a view to improving piston ring operation.

Paraffin base oils have higher resistance to high temperatures and oxidation than other types of non-additive lubricants. The physical properties of this type of oil permits its use over a wide range of engine temperatures per grade of oil, without undue risk of mechanical difficulties due to changes in viscosity, but it is a recognized fact that carbon deposits left by paraffin oils in high temperature service are hard and dry.

Napthentic base oils have a lower initial carbon content in many cases, and the deposited carbon is comparatively soft, although this type of oil has a lower resistance to high temperatures and oxidation, and its viscosity index limits its use to a narrower range of engine temperatures per grade of oil than can be tolerated by the paraffin type of oil.

Assuming that napthenic oil has a greater solvent effect than the paraffinis type, and also that there would be less resistance to oxidation, then the oil quality should deteriorate more rapidly. The clarifiers, however, should compensate for any disadvantage and maintain the required oil condition. In doing so the length of service normally expected of clarifier cartridges would be decreased in proportion to the increased work to be done. In a long range plan to improve piston ring performance, the anticipated increase in clarifier maintenance cost would be amply jus-

tified, if costly overhaul periods could be spread further apart.

Two engines in one battery were selected for comparative tests. Both machines operated on the same service and controls; therefore the conditions of load, speed and temperature would be exactly the same at all times. Both machines were also equipped with identical clarifiers. All pistons and rings were thoroughly cleaned and the machines were reassembled, with the pistons in the condition illustrated in Fig. 1. Paraffinic base oil was used exclusively in one machine and the other was confined to the Nepthenic base oil. The oils in question had the following characteristics:

		Paraffinic	*Nepthenic*
Saybolt Viscosity	100°F.	530 Secs.	627 Secs.
" "	170°F.	170 "	180 "
" "	210°F.	66 "	63 "
Flash Point		450°	435°
Pour Point		–10°	–5°
C. C. R.		.014	.205

The difference in viscosity will be noticed, but at the average engine oil temperature the difference was not great enough to be significant, and this temperature is very closely controlled. There is a considerable difference in the Conradson carbon residue, but there is also a difference in the character of the carbon deposit. The paraffinic deposit is sticky and the nepthenic deposit is soft and fluffy. At the end of 1,000 hours operation No. 1 piston on each engine was taken out for inspection and comparison. This disclosed the condition shown in Figs. 2 and 3.

The paraffinic oil had left a fairly thin but hard deposit on the piston face above the top ring (Fig. 2), with numerous vertical irregular cuts, suggesting considerable working of the carbon while against the cylinder walls while still in a plastic state, but the cylinder showed no sign of scuffing or scoring. The top ring groove contained carbon behind the ring. This was not quite as brittle as that on the piston face. The lower rings were free, with a few light scratches.

The nepthenic oil had left scarcely any deposit, as can be seen in Fig. 3, and both piston and rings were free from vertical markings. The light precipitation of carbon was oily and was afterwards removed with a cloth without difficulty.

Fig. 4 illustrates number two piston after 2,000 hours operation with paraffinic oil. The carbon was heavier, the ring grooves showed signs of increased carbon thickness, and the oil rings were also sluggish and sticky when the piston was cool.

No. 2 piston, after 2,000 hours operation with napthenic oil (Fig. 5) showed very little change from the condition of No. 1 at 1,000 hours, and when cool the ring action was quite free.

Fig. 6 is a closeup of No. 3 piston at 4,000 hours on nepthenic oil. The carbon in the top groove behind the ring has been chipped out to show the depth of deposition. This was soft and easily removed. The deposit on the piston face was still light and all rings were free.

Fig. 7 is a closeup of No. 3 piston after 4,000 hours operation on paraffinic oil. The precipitation was definitely hard and dry, and the top ring was stuck in the groove and had to be broken for removal. The photograph shows quite clearly the thickness of carbon behind the ring and also the extent to which this deposition had built up until it was bearing hard against the back of the ring at the lower side of the groove.

Various types of piston rings had given equally varying results under test, and some types were rejected as unsatisfactory. There were differences in rates of wear and some rings had a definite tendency to stick in the grooves sooner than others. Under conditions of controlled lubrication, however, there was a very great improvement, and types of rings which had previously given considerable trouble were tested again and gave excellent results. Figures 8 and 9 are typical graphs developed to show the rate of cylinder wear under varying conditions and for comparative operating hours. These two engines are both rated at 850 B.H.P., and as in the tests already discussed the machines chosen operated under identical conditions of hours, load, temperature and speed. The measurements quoted are averages of the cylinder dimensions taken from all eight cylinders, with calibrated instruments at room temperatures, at points in the stroke shown on the vertical line of the chart.

On both charts the tabulation shows the actual wear rates in each curve. Line A. is the first tabulation, line B. represents the second run and line C. is the sum of A. and B., or the total life of the engine.

Line A. Fig. 8, shows a severe wear rate at the top 3" of the cylinder and a more normal condition for the remainder of the piston travel. Comparing Line A, Fig. 8, with Line A. Fig. 9, there is a considerable difference in the wear rate in No. 2 engine all the way down. As both engines use the same fuel gas under the same conditions, this difference in average wear may be due to a difference in combustion. If this is true it would indicate that even a vary slight difference in fuel/air mixture may have a far-reaching effect on cylinder wear when any corrosive elements are present in the fuel.

On the second tabulation indicated by Line B an improvement in cylinder wear is quite definite in No. 2 engine (Fig. 9), although the greatest loss still takes place in the top 3" of bore. This improvement is due to improved methods of lubrication. The quality of the fuel did not improve during this period, as compared to the first curve interval; in fact, the average condition was probably worse, with a higher H_2S concentration in the fuel gas. There is every reason to beleive that if the fuel gas quality had remained constant, the improvement in Line B. would have been more pronounced.

Up to this point in the test both machines had used standard cast iron piston rings of the same make and specifications. Special chrome plated rings were installed in the top ring grooves only in all pistons in No. 1 engine. Line B, Fig. 8, indicates the effect on the cylinders of this engine. There is an extraordinary decrease in the wear at the top of the stroke. There is also a somewhat unexpected increase in wear from the 3" to 6" points in the stroke. Apart from this area the general wear has improved. The improvement is doubtless due to a combination of chrome plated rings and improved lubrication. The increased wear at the 3" to 6" area is probably due to the mechanical action of the hard chrome surface on the cylinder walls, working on the sharp taper left by the softer iron rings at the 3" point. The net result is a more gradual taper all the way down the stroke, as demonstrated by Line C, Figs. 8 and 9.

The wear on the piston rings lends support to this theory. In the top ring position chrome rings showed very little wear; four rings had an average gap increase of .005" after 13,600 hours operation; the gap increase on the other four was too small to be measured accurately.

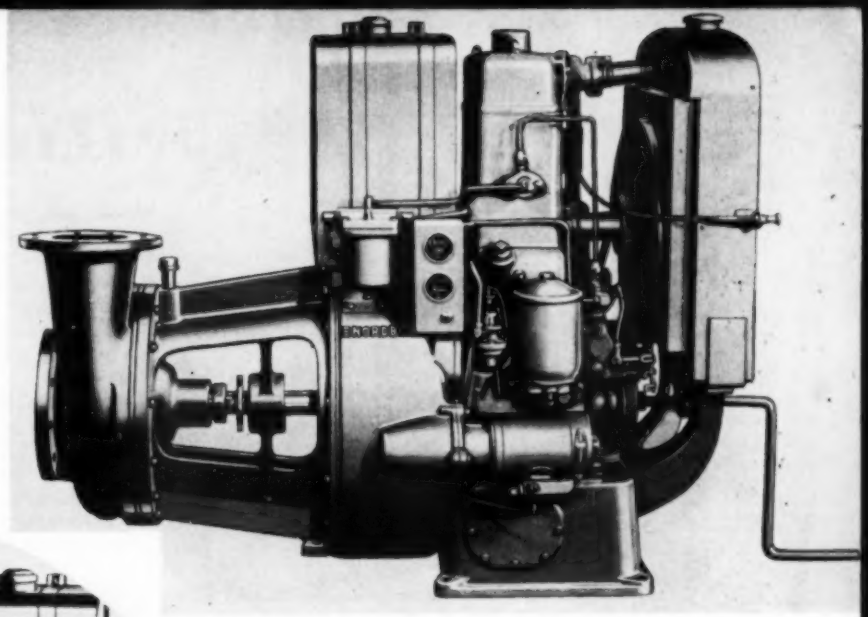
Standard iron rings in the top grooves on No. 2 engine disclosed a wear of .063" increase in the gap after 14,600 hours operation.

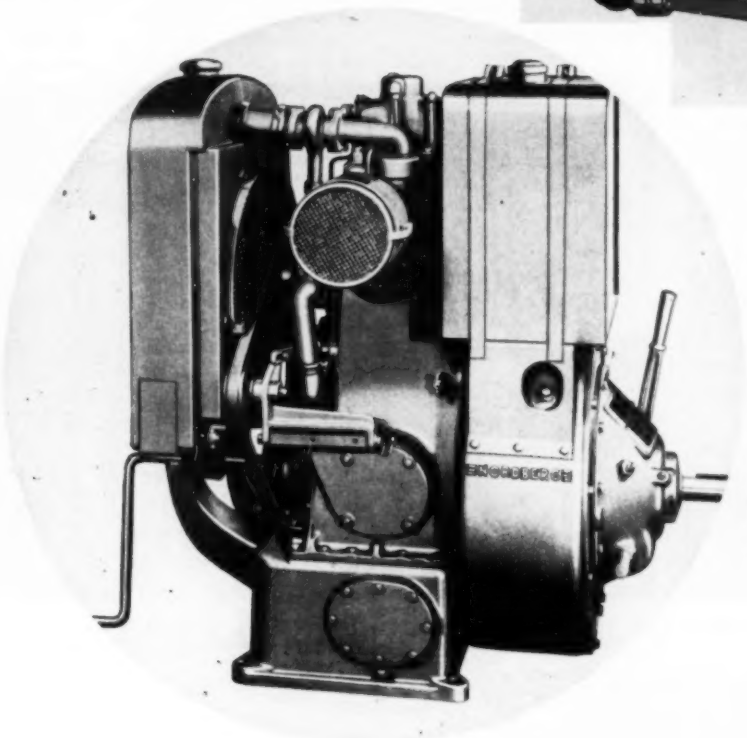
There is frequently some variation in the rate of wear between cylinders on the same engine. This is true of the wear of individual piston rings, but there can be no question of the general improvement of piston ring life and performance. This has progressed to the point where 25,000 hours life can confidently be expected, as compared to a former service of 5,000 to 10,000 hours as a maximum.

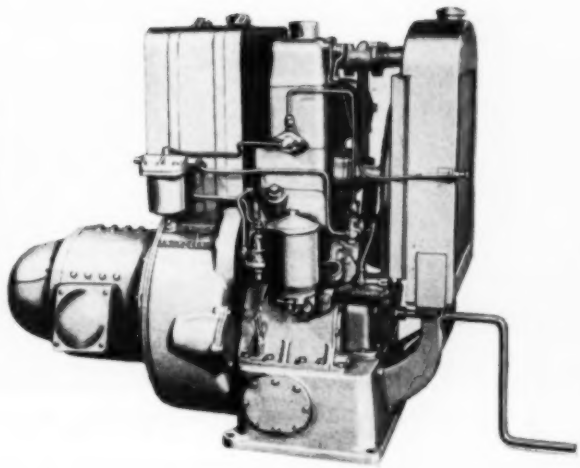
The tests have emphasized the importance of local study under operating conditions and also the equally important task of collecting all possible data and correlating all factors in their relationship to each other.

NEW NORDBERG 10-15 hp SINGLE CYLINDER DIESEL

By J. D. GRACE







AFTER extensive development work and experimental pilot model production, Nordberg Manufacturing Company announces a new 10 hp. diesel engine. Known as Type 4FS-1, this new engine is an extra heavy duty vertical type, four-cycle, single cylinder, mechanical injection engine. It has a 4½ in. bore and 5¼ in. stroke and is conservatively rated at 10 hp. at 1200 rpm. and 15 hp. at 1800 rpm. Production is expected in the near future of two and three cylinder models of the same bore and stroke with proportionately higher horsepower ratings. This engine is now available for immediate delivery. This new engine augments Nordberg's world-known line of two and four cycle diesel engines with ratings from 175 hp. to 8750 hp. for oil, natural gas or combination fuels for stationary and marine installations.

The new Nordberg engine is available for all small stationary and portable power applications as electric generating units, pumping units and power units for belt or chain drive or direct connection and also with a stub shaft for direct connection, it is also available for marine auxiliary applications. The engine is a completely self-contained unit ready to put into service. Its ten-gallon tank provides sufficient fuel for 12 hours of operation at full load.

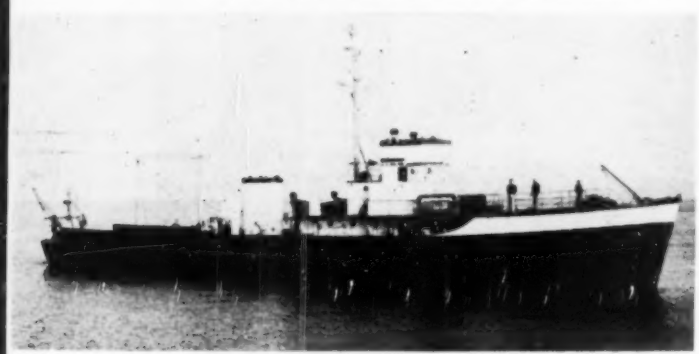
Full pressure lubrication is provided to all crankshaft, connecting rod, piston pin, camshaft and rocker arm bearings. The piston is splash lubricated by the oil emitted from the connecting rod bearing at the crank webs. Lube oil entering the suction side of the pump passes through a float strainer. The pump then circulates lubricating oil through a tubular heat exchanger located within the cylinder block, and then to the various pressure lubricated parts of the engine. A by-pass filter continuously cleans a portion of the oil in circulation. An impeller type cooling water pump, belt driven from the crankshaft, circulates water from the radiator to the cylinder block where it flows upward around the cylinder liner, and into cylinder head passages to efficiently cool the combustion chamber, fuel nozzle, fuel injector, valves and exhaust passages. Passing through the outlet manifold at the top of the cylinder head the water is returned to the radiator. A thermostat and recirculating connection is installed in the outlet manifold for automatic control of the cooling water temperature. A diaphragm type fuel oil transfer pump is adjusted to deliver fuel at an approximate pressure of 3 lbs. through a fuel oil filter to the fuel injection pump. The fuel injection pump delivers fuel at high pressure through extra heavy steel tubing to the injector nozzle in the cylinder head. A vent line from the spray nozzle returns excess oil to the main fuel supply. The engine is offered for hand starting with 12 volt electric starting available as optional equipment for this new model.

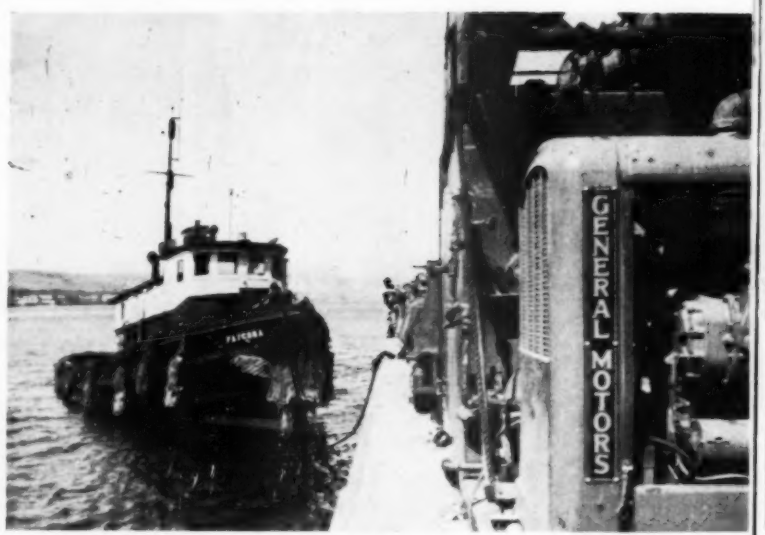
DIESELS IN

Signal Oil & Gas Company In Santa Rosa Island Operations Use Diesel Engines in Many Applications

Machinery equipment of the tug "Kanak" is comprised of an impressive group of diesels and accessories. Main propulsion units are two 350-hp F-M diesels, replacing steam. A 200-hp Cummins diesel driver, an I-R compressor, and there is an F-M 30-hp diesel-compressor unit and an F-M 15 kw diesel-generator set.

↓ Signal Gas and Oil Company's 136' YMS, La Busca, powered with three General Motors 500-hp diesels for propulsion and auxiliary power.





↓ First below: Tractor, at left, holding barge in snubbed position. Blitz rig ready to unload. Second below: Tractor pulling blitz rig off of barge.

↑ Patcona, 75' tug, is powered by a 240-hp F-M diesel. Note G-M diesel-generating set on barge in foreground.

EXPLORATORY DRILLING

SANTA ROSA ISLAND, about 17 miles long and 10 miles wide, in the Pacific Ocean 30 miles southwest of Santa Barbara, Calif., has an inhospitable coast line, a rugged terrain, no road system and little population. The big Vail Ranch interests run several thousand cattle on the island where there is enough rain to nourish the green stuff that the animals chew.

Signal Oil & Gas Company, with headquarters in Los Angeles, believe there is oil under the island and they are taking major steps to find out. In all of the operations leading up to the actual drilling and in the drilling, diesel engines play a prominent part. In fact they furnish the power for practically everything that goes on except some trucking and the Allied Air Service planes used for fast transportation of personnel and emergency supplies. Even in the heavy aspects of trucking, "Caterpillar" diesel-powered tractors do the pulling and pushing as will be seen.

Signal's 136-ft. YMS, *La Busca* is powered with three 500-hp. General Motors diesels for propulsion and auxiliary power (including the ship-to-shore radio). This vessel plies back and forth from Stearn's Wharf in Santa Barbara to the Vail Ranch pier jutting out from the island, close to ranch headquarters, as required to carry personnel and freight. However the pier is of too light construction to sustain the weight of heavy drilling equipment; therefore it was landed from beached barges.

After preliminary preparations had been made, in late August 1948, the first, heavy barge load of equipment was towed from Long Beach to the landing beach at Beecher's Bay at the mouth of Water Canyon. The converted, 75-ft. Army tug *Patcona*, powered with a 240-hp., 6-cyl. Fairbanks-Morse diesel, towed the first, 120-ft. x 34-ft., 900-ton capacity barge. The cargo included two D8 "Caterpillar" tractors, road grading equipment, water tanks, trucks, trailers, diesel fuel tanks, and 30,000 ft. of pipeline.

Later barge loads were towed by Pacific Towboat & Salvage Co., Long Beach, tug *Palomar*, with an Atlas Imperial, 400-hp. diesel for main power, and a 20-kw., 2-cyl. GM diesel-generating set for auxiliary power; and by their 120-ft. x 24-ft. *Kanak*, with twin screws driven by two 350-hp., 8-cyl. Fairbanks-Morse diesels.

The Vail "Caterpillar" RD-7 tractor with bulldozer and pull-grader were used to prepare the beach and re-work five miles of old road to the camp site. Camp erection was completed early in September, with mess hall, shop and generator buildings included. A 15-kw. GM Delco diesel generating set mounted on a trailer supplies power for the camp—lights, refrigerators, deep freeze units; motors to operate drill presses, grinders, welding equipment, etc. in the shop.

Tractors were used to grade six miles of new road from the camp to the site of the first well, Soledad No. 1. For two weeks water was tank-hauled from the Vail water supply while a new water tank was erected and connected with a pipeline to a dammed-up spring in Water Canyon.

In October everything was ready for the second, 900-ton barge load of drilling equipment. This was unloaded in the same manner as barge 1 The barge was beached at high tide. A sand ramp was "dozed" up to the end of the barge. Heavy ropes from each side of the front end of the barge were run through pulley blocks attached to "dead men" (buried posts) and then the two tractors on each side, to hold the barge firmly on the beach.

A bridge was laid from barge to ramp, with a track beyond it on the ramp. Then the low-bed trailer carrying the Blitz Rig was pulled off with one of the tractors. Followed then, the removal of the mud pump and other equipment and supplies. Two "Cats" pulling and one pushing were used going up the nearby grade with each heavy trailer load.

The equipment brought on Barge No. 2 consisted of Santa Fe Drilling Company's Indreco drilling unit; the Blitz Rig, drawworks using a 671 GM twin diesel through a torque converter for power with another 6-71 hooked to a 7¼ x 14 Gardner-Denver compressor; the mud pump with duplicate pumps powered with two 6-71 GM twin diesels; and the 25-kw., 3-cyl. GM diesel-generating set for auxiliary power. With the 12 ton rotary table and base, the drilling equipment proper weighed about 105 tons; other miscellany weighed about 60 tons, and there was also about 100 tons of Kelly drill pipe, drill collars, pipe, blocks, etc. All of the equipment was then pulled by the "Cats" over the old and new road to the well side, set up and ready to drill in November.

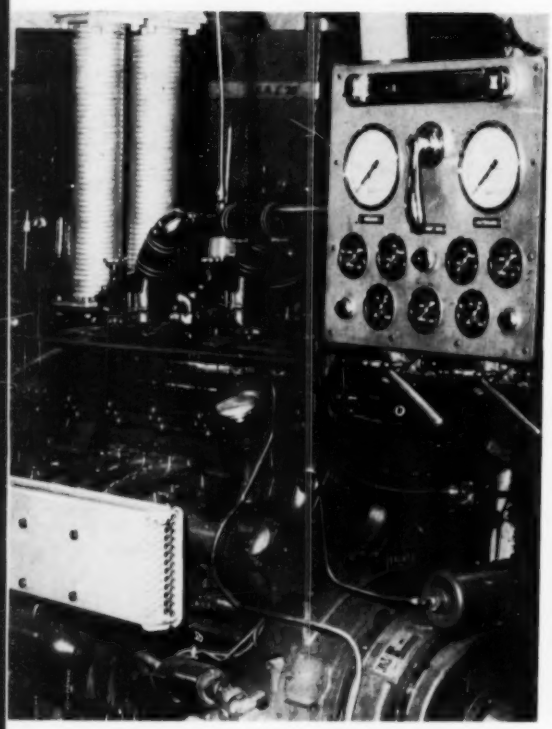
Barge No. 3, a smaller, 90-ft. x 30-ft., 400-ton unit, brought over a light load of miscellany and returned the trailers. Barge No. 4, the same unit, delivered two loads of pipe and the Electrical Logging Truck.

Caterpillar tractor pulling unloaded blitz rig up hill while mud pump comes off barge.

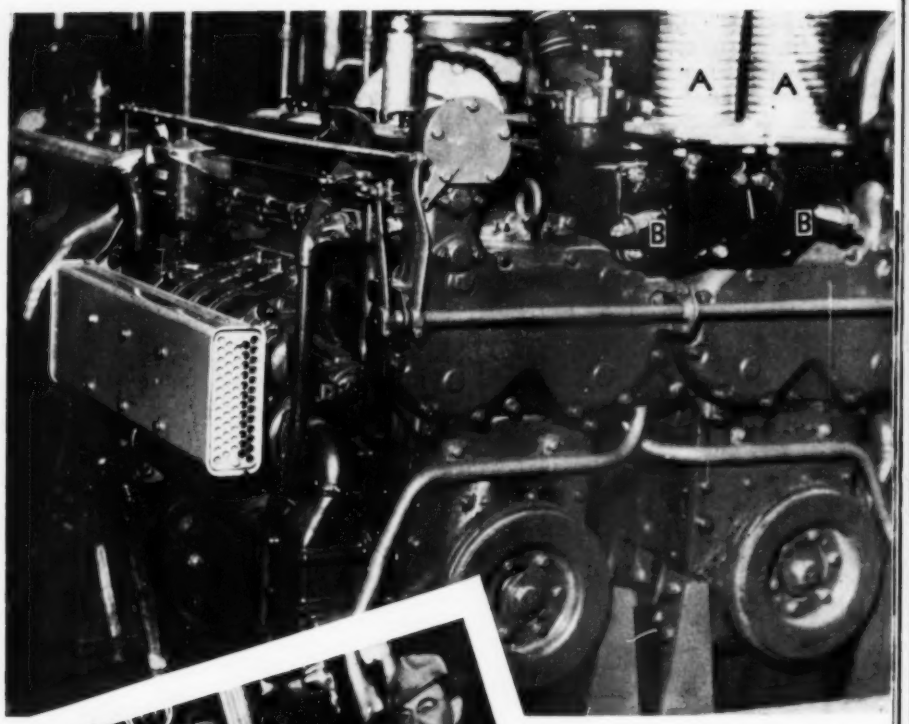
Diesel-engined, portable oil well drilling rig under erection at site of well, Soledad No. 1.

SEATTLE FIRE BOAT MODERNIZED BY SIXTEEN DIESEL ENGINES

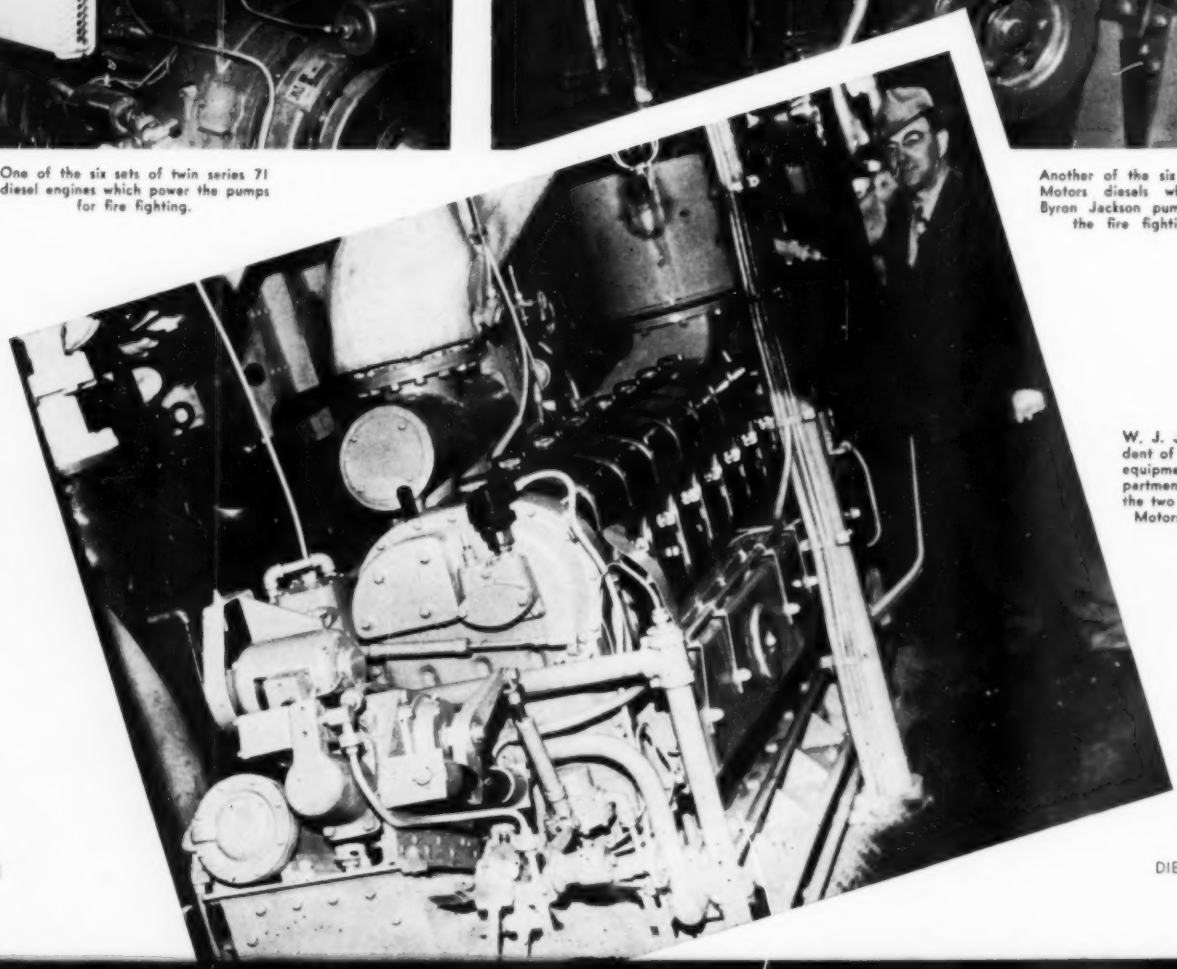
By W. J. GRANBERG



One of the six sets of twin series 71 diesel engines which power the pumps for fire fighting.



Another of the six sets of General Motors diesels which power the Byron Jackson pumps which supply the fire fighting monitors.



W. J. Jones, superintendent of maintenance and equipment for the Department, beside one of the two 500 h.p. General Motors main engines.

INSTALLATION of sixteen diesel engines in the 22-year-old *Alki* has given the Seattle, Wash., Fire Department one of the most modern pieces of marine fire fighting equipment in the nation by increasing pumping capacity by 30 per cent, reducing the engine room crew, and providing for more economical and efficient operation of the ship. The extensive modernization program which has just been completed saw three gasoline propulsion engines and gasoline pumping units removed from the vessel, which was built in 1927 as a triple-screw fire fighter. The steel hulled *Alki* is 123 ft. six in. long, 11 ft. deep, and has a beam of 26 ft. The conversion work reduced the number of propellors to two, while two rudders were installed to replace the single one formerly used, factors which have increased maneuverability.

The new power plants in the *Alki* are General Motors diesels. The two propulsion engines are Type 8-268-A. These eight-cylinder, two cycle units with a bore and stroke of 6½ in. x 7 in., turn up 500 hp. each at 1270 rpm. They are cooled with Ross Coolers, one each for water and one for oil. The built-in reduction gear has a ratio of 2.54 to 1. The engines are air-started, have reversing gear. The main engines' starting switches, throttles and clutch controls are situated in the pilothouse. The propulsion engines, driving the vessel at 14 knots, can bring the ship from full ahead to stop in 35 seconds. They use approximately 30 gals. of fuel an hour. Fuel capacity of the *Alki's* tanks is 7,000 gals. Formerly, three men were required to man the engine room, while now only one is needed. A fact which makes more men available on deck for fire fighting. Speedier and more efficient handling of the ship, with no lag in engine room signals, have resulted from full control of the main engines from the pilothouse.

To power the Alki's Byron Jackson four-stage centrifugal pumps which supply the monitors on deck, six sets of twin Series 71 General Motors diesels were installed. These twin six-cylinder units, mounted on a common bed and tied to a common shaft, provide a total of 300 hp. per twin at 1800 rpm. They have a bore and stroke of 4¼ in. x 5 in. and a displacement of 851.2 cu. in. One twin unit uses about 15 gal. of fuel per hour under normal operation. The reduction between engine and pump is 1:1.56.

For cooling, four engines are grouped into one fresh water cooler which employs a Ross heat exchanger. Rather than have six sets of starting batteries for as many twin units, a single set of heavy-duty batteries was wired to all pump engines for a common power source for starting. The pumps discharge into a 200 gal. expansion tank from which all the fire fighting monitors are fed. To offset the jet thrust from the monitors, which is strong enough to move the ship rapidly away from a dock when a fire is being combatted, there are two jets in the hull on each side of the *Alki*, one forward and one aft. When the vessel is fighting a blaze and has the monitors on one side shooting water, then the jets on the opposite side of the hull, which are two and one-half in. in diameter, are turned on to counteract the thrusting force of the streams of water from the monitors. For ventilation purposes, and to assure a supply of fresh air despite smoke and fire, there is an intake valve in the hull, at water level, on each side of the ship, with the one away from the fire in use during a blaze.

When the *Alki* is in her dock on stand-by status, electric power is drawn from a shore line, but when under way two 30 kw. generators are put into service. Each is driven by a three cyl., two cycle, Model 71 General Motors diesel engine.

One of the innovations instituted during the modernization program was a heating system by which all engines are kept warm for immediate starting. This consists of an oil fired boiler and a one-half horsepower pump which circulates to the engines from a common tank and expansion head at a temperature ranging from 90 to 100 degrees. In addition to making possible the instant starting of all engines, the hot water heats the vessel. When the engines are started and the ship is to get under way, the boiler circuit is closed by a single lever action gate valve and the shift is made to the water cooling circuit.

Although the hull of the *Alki* provided enough space for orderly, roomy and efficient installation of the new engines, sixteen diesels added up to a noise problem which Fire Department technicians solved satisfactorily. Silencing of the two propulsion engines was accomplished by means of Burgess silencers in the stacks, which left the pump and generator engines to silence. This was done by making an expansion chamber which was installed over each twin-six unit, with the exhaust from each of the six-cyl. engines going into it through flexible connections. The dry-type silencer, or expansion chamber, is 38 in. high and 18 in. in diameter. In it are three acoustical labyrinths. The lower one, where the exhaust enters, is a clear chamber. The second one consists of pipes, and the third one, from which gasses move to the stack, is clear. Perforated rings form the walls of these labyrinths. The principle of the silencer is that the noise level is reduced as the sound waves and gasses expand. Operation of the engines with the new silencers indicates the technicians did accomplish a material reduction in the noise. The exhaust manifold and elbows in the flexible connections are of vitraeous baked enamel. In the elbow from each engine there is a thermo-couple to tell stack, or exhaust temperature. W. C. Nickum & Sons, Seattle naval architects who designed the *Alki*, did the planning for installation of the sixteen diesel engines, as well as the propellor and rudder work. W. J. Jones, superintendent of equipment and maintenance for the Seattle Fire Department, directed the job. Conversion of the pumping engines was done by department personnel, while the remainder of the modernization work was done by the shipbuilding division of Puget Sound Bridge & Dredging Co.

Sixteen diesel engines transformed this 22 year old Seattle fireboat into a modern piece of fire fighting equipment.

TRUCKING + DIESELS = PROFITS

By
FRED G.
WITMAN

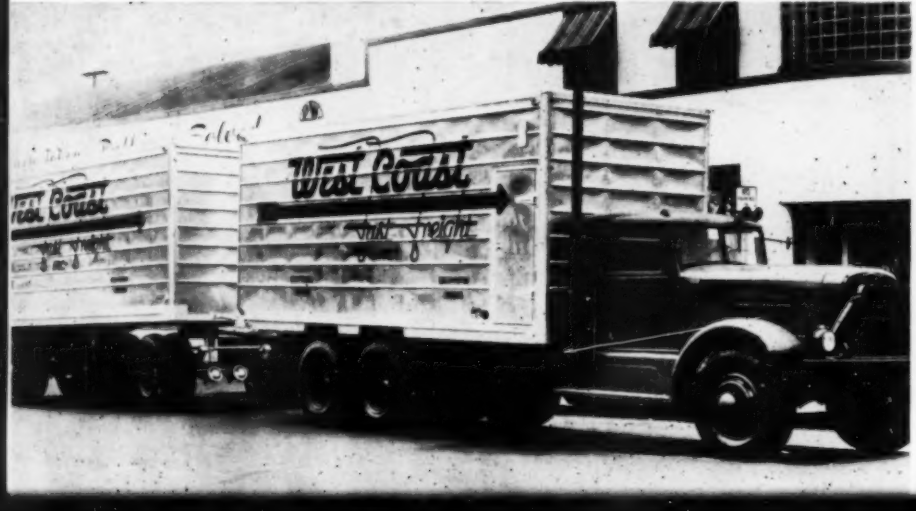
Inland Freight Lines, Salt Lake City, Utah, has standardized on Cummins diesels in Peterbilts for freight hauling on the tough run between Salt Lake City and San Francisco.

Four of a total of 132 Cummins-powered rigs used by Pacific Intermountain Express. Trucks in the P.I.E. fleet move 20,000 tons of freight two million intercity miles per month.

DIESEL engines have made it possible for the trucking industry to play an important part in the economic development of the west. In turn, the tremendous distances, power-consuming grades and extreme variations in temperature characteristic of western highways have had much to do with the development of the automotive diesel. West Coast trucking operators need powerful engines to haul profitable payloads over the highways of this proving ground for power. Here 1,500 to 2,500 mile hauls are common, with 100 mile stretches of five to eight per cent grades. Engines must be able to function at top efficiency from sea level to mountain passes 11,000 ft. and more above sea level. They must deliver full rated torque and horsepower while encountering temperature variations ranging up to 60 degrees within a few hours running time.

Pacific Intermountain Express is typical of the large fleets that engage in heavy-duty highway operations. The far-flung system of the P. I. E. links San Francisco and Los Angeles with Salt Lake City, Denver and the Middle West. Working on an around-the-clock basis, P. I. E. trucks handle 40 million pounds of freight a month. Their diesel powered Peterbilt tractors average 500 miles a day each, and the average cargo haul is 1,500 miles. On their long runs, hauling payloads of 20 tons or more over the vast mountain ranges and deserts between the Pacific Coast and the Middle West, the trucks in the P. I. E. fleet meet and overcome the toughest highway problems. Steady grades for distances of eight to ten miles are common. On the west slope of the Sierras the elevation increases 70 feet per mile for nearly 100 miles, calling for plenty of reserve power. On this particular run the use of Cummins "NH" engines has boosted the speed over the 8,000-ft. Sierra Nevada Mountains by one gear ratio, and at the same time has reduced fuel consumption. P. I. E. has standardized on Cummins diesels for their long-line operations, and uses a total of 132 Model HB and NHB engines—all in Peterbilt tractors.

One of the 120 Cummins-powered trucks owned by the West Coast Fast Freight, Inc. of Los Angeles, which averaged 3,000 miles per week hauling from Southern California to British Columbia and return.



Loveland Pass is 11,992 feet above sea level, and to reach it requires a steady climb for most of sixty miles. This pass is on the regular run of five Cummins-powered Kenworth tractors owned by Ringsby Truck Lines, Denver, Colo.

Another big user of diesels in highway hauling is West Coast Fast Freight, Inc., with headquarters in Los Angeles. Trucks in this fleet encounter every conceivable climatic and road condition on their regular runs. They take the "ridge route" north out of Los Angeles, swing over to San Francisco, and then head on into the Siskiyou regions of the Northwest. On another run, these trucks start from Los Angeles and maintain fast schedules on the desert and mountain highways that lead to Denver.

In the Northwest, West Coast Fast Freight, Inc., makes three trips daily from the Yakima terminal to Portland and Seattle. West Coast's diesel-powered trucks make the 195-mile run to Portland in six hours, crossing 3,149-ft.-high Satus Pass by means of the hairpin curves of the steep Marvhill Grade. To Seattle, the climb is over 3,000-ft. Snoqualmie Pass through the Cascade Mountains. This 150-mile trip is made in four hours. Drivers in this fleet claim that these two climbs are the toughest in the West. West Coast Fast Freight Inc., uses a total of 120 Cummins diesels, powering Autocar, Kenworth and Peterbilt tractors.

Los Angeles-Seattle Motor Express, Inc., Seattle, Washington. Operates in Washington, Oregon and California, and has 11 terminals in these three states. Their truck and full trailer combinations carry 72,000 pound gross loads, and are governed at a top speed of 40 miles an hour. On the "ridge route" from Seattle to Los Angeles, these trucks make the 2,500-mile round trip in 80 hours. Los Angeles-Seattle Motor Express has used Cummins diesels for more than 12 years, and currently operates 72 Cummins-powered tractors. These include "Western" Internationals, Peterbilts, Kenworths, Autocars, Sterlings and Whites. Five of the Cummins diesels powering trucks in this fleet have gone more than a million miles each. Of these five engines, three are between 10 and 11 years old; two were purchased in 1940 and 1942.

Forty-five Cummins-powered tractors in the Lee and Eastes, Inc. fleet cover more than 3,000,000 miles each year hauling 240,000,000 pounds of dry freight.

Lee and Eastes, Inc., Seattle, Washington, operates mainly in Washington and Oregon as far as freight hauling operations are concerned, with eight terminals in these two states. The freight trucks in the Lee and Eastes fleet are all truck and full trailer combinations, and carry 72,000-pound gross loads. These freight trucks average 55,000 to 60,000 miles each month. Under full load, they make the 189-mile run from Seattle to Portland in seven hours, and the 150-mile run from Seattle to Yakima in five and one-half hours. A total of 45 Cummins diesels are used by Lee and Eastes, Inc., powering Sterlings, Kenworths and Fageols. Of these diesels, 27 power freight trucks, and 18 power tanker units that are used in an 11-state petroleum products hauling operation. Some of the Cummins diesels in this fleet have gone 800,000 miles, and the fleet average is 400,000 to 500,000 miles per engine. These diesel engines average 70,000 miles between overhauls. Inland Freight Lines, Salt Lake City, Utah, operates a fleet of freight trucks on the tough run from Salt Lake City to San Francisco. This haul is 768 miles one way, and along the route are encountered the steepest of grades, and six temperature extremes. Leaving Salt Lake City, the trucks cross Salt Flats at an elevation of approximately 4,000 ft. and go up to 5,940 ft. at Silver Zone Pass. At the Pequop Mountains, the pass is 6,980 ft. above sea level. Next, the trucks go down to 6,114 feet at Emigrant Pass. The highway drops again, crosses the valley, and ascends Saddle Mountain with the pass at an elevation of 4,912 ft. After crossing the Golconda Mountains at 5,154 ft., the trucks "float" into Reno, 4,484 ft. above sea level. The toughest climb of all is the one across the Sierra Nevada Mountains through Donner Pass. The elevation at this point is 7,135 ft. The highway then goes down and down to approximately sea level at San Francisco. The trucks used by Inland Freight Lines on this run carry gross loads of 70,000 to 80,000 pounds, and average 98 per cent loaded on all trips. Six of the Cummins diesels placed in operation last year have accumulated 189,600 miles in 54 weeks. Inland Freight Lines standardizes on Cummins diesels in Peterbilt tractors, using 12 on this run.

Ringsby Truck Lines, Denver, Colorado, uses five Model NHB-600 Cummins diesels to power Kenworth tractors used on the run between Denver and San Francisco. About 60 miles west of Denver these trucks cross Loveland Pass, an elevation of 11,992 ft. There is plenty of snow at this height, but the roads are kept open the year around, and are made difficult by hairpin turns. These companies are only a few of the fleet operators in this western territory who are using diesels to overcome the obstacles that face all truckers in the west. For these and many other operators, diesels are not only helping solve the problems of long runs, steep grades and severe climatic conditions, but are giving freight trucks longer between-service periods, improved fuel economy, and all-around low-cost operation.

PISTON RING AND CYLINDER WEAR IN DIESEL ENGINES

SCUFFING TESTS

LUBE OIL	TEST SEVERITY				
	1	2	3	4	5
OIL D	1 PASS	1 PASS	2 FAILURES		
OIL D + SULFURIZED SPERM OIL			3 PASSES	4 PASSES	2 FAILURES

RING FINISH	TEST SEVERITY				
	1	2	3	4	5
COARSE TURNED		1 PASS	1 PASS		3 PASSES
LAPPED	1 PASS 1 FAILURE		2 FAILURES		2 FAILURES

Fig. 1

By JOHN W. PENNINGTON**

WEAR of the piston rings and cylinders in an engine is one of the primary problems which has always faced engine builders and operators. The usual reasons for rebuilding an engine are high oil consumption and blowby. The usual remedy for the trouble is new piston rings and in engines which have cylinder liners, new liners. We generally become concerned with the problem of piston ring and cylinder wear when situations of abnormally high wear are encountered. It may be just as important, however, to look at the engines which wear at a rate which is a small fraction of the rate we have come to consider normal. The same engines made of the same materials will wear at rates differing by a ratio of one hundred to one under conditions apparently not greatly different.

In this paper wear will be defined as any removal of material from its original position in the piston ring or cylinder surface during the operation of the engine. Investigators in the field of wear of metals have found several processes by which metal can be removed from a surface. We shall try to point out, for the case of piston ring and cylinder wear, the most important factors influencing the wear by each process. The work reported here has been done on four-cycle precombustion chamber type diesel engines running at speeds of 1000 to 1800 rpm. In all cases, except where otherwise stated, cast iron piston rings and induction hardened cast iron liners were used.

Methods of Measurement: Ring wear has been measured by the increase in ring gap when the ring is confined in a standard gauge. Gap measurements have usually been made with a feeler gauge. In some cases a microscope has been used.

Cylinder wear has been measured in most cases by using a .0001" indicator to traverse the wear step in the cylinder. In earlier work cylinder wear was measured by means of a dial bore gauge, but this meant measuring a small change in a large dimension and gave little information concerning wear distribution. By measuring the wear step an actual radial measurement is obtained of the amount of material removed at any position. In our laboratory it has become common practice to measure the wear step in 24 locations in each cylinder and to make at least one complete lengthwise traverse of each cylinder.

As a logical starting point for investigating the wear of any part, we might seek answers to the following two questions:

1. What are the processes by which material is removed from the surfaces?
2. What are the principal factors which influence the rate at which material is removed by any one of these processes or any combination of these processes?

The processes by which material can be removed from rubbing metallic surfaces have been divided in several ways. The following division seems to cover the field of piston ring and cylinder wear in so far as we now understand the subject:

1. Direct mechanical action of one surface on the other.
2. Scuffing, or the welding of points on one surface to points on the other surface and the subsequent tearing of the welded junctions.
3. "Surface disintegration," which we shall consider as a form of surface fatigue caused by the stresses created as one part passes over the other part.
4. Abrasion. (Mechanical action with foreign particles present).
5. Corrosion.

Each of these processes will be discussed individually and the influence of the principal factors in each case will be described. It is seldom that one process is solely responsible for the wear, but it is usually found that one process is the basic cause of abnormal wear. In all cases the materials which are present at the point at which wear is taking place will have an important influence so that the following factors will always be involved:

1. Properties of the piston ring material.
2. Surface condition of the piston rings.
3. Properties of the cylinder material.
4. Surface condition of the cylinder.
5. Properties of the lubricant.
6. Quantity of lubricant available at the point in question.

Fig. 5

EFFECT OF LINER WALL TEMPERATURE ON WEAR PATTERN

·1% SULFUR FUEL · 100°F JACKET OUTLET

75 BMEP · 1000 RPM

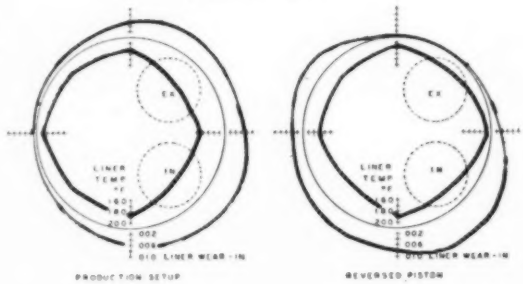
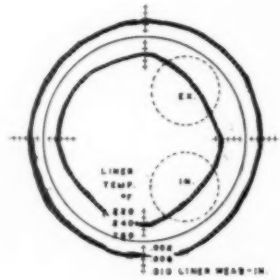


Fig. 6

CYLINDER WEAR PATTERN
HIGH SULFUR FUEL
NORMAL JACKET TEMPERATURE



** Staff Engineer, Research Department, Caterpillar Tractor Co.

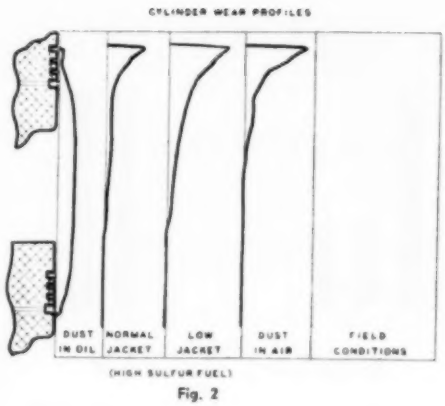


Fig. 2

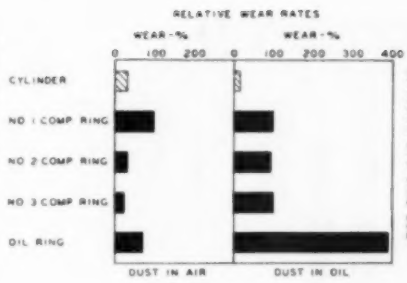


Fig. 3

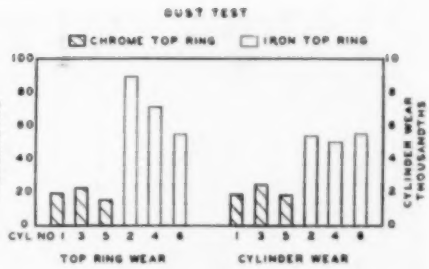


Fig. 4

Other factors which have an influence are the pressure, temperature, and rubbing velocity at the point being studied. In some cases materials brought into the engine have an important effect. These will be discussed as they are met.

Wear by Mechanical Action: In any case where the piston ring is moving over the cylinder surface the surfaces will actually be in close contact at relatively few points due to irregularities of the surfaces. It is easy to picture then, that irregularities on one surface will cut off or deform irregularities on the other surface. This is one of the things that happens when an engine is broken in and under proper conditions will lead to a smoothing of the surfaces, an increase in the area of actual contact and an improvement in the load carrying ability of the surfaces. Rapid wear is usually associated with the break-in period and such wear is desirable in that some wear must take place before the parts can fit properly. This type of wear depends on three factors:

(1) Surface Condition—If both surfaces reach a form such that the interlocking of high spots is reduced to a minimum, wear by this process may virtually cease.

(2) Material Properties — Hardness and the relative hardness of the two parts is a factor. Hardness determines how far points on one surface will penetrate the other surface and which part will cut the other.

(3) Lubricant—The viscosity of the lubricant has an effect since it helps to determine how close the two surfaces will approach each other. We have frequently observed that original finish marks are removed much sooner when a light break-in oil rather than a heavy oil is used.

Scuffing: The second process which may take place is the phenomenon commonly called scuffing. Scuffing is usually pictured as the welding of points on the two surfaces and a subsequent tearing away of the welded junctions. This manifests itself in a roughened condition of the cylinder and a high wear rate of the rings and pistons.

Several factors affect the scuffing problem:

(1) Surface Condition. Scuffing is a particularly critical problem during the break-in period. During this period there is considerable intimate contact of high points and therefore opportunity for scuffing to occur. For welding to occur, a high surface temperature must be reached, and there must be clean metallic contact. Any contaminating film will aid in preventing scuffing. Chemical coatings of various types have been used very effectively in preventing break-in scuffing. Various types of interrupted surfaces have also been successfully used to prevent scuffing.

(2) Just exactly which properties make a material resistant to scuffing have not been explained. By experience we know that certain materials, such as cast iron, are good in this respect while others, such as steel, are inclined to give trouble. A common rule has been to note use the same material for both parts. Cast iron rings, however, are used very successfully in cast iron cylinders.

(3) Lubricant: The viscosity of the lubricant has an effect on scuffing. Heavy oils provide a film which is more difficult to penetrate. Volatility may have an appreciable effect in that it determines how well the oil resists being burned from the surface. E. P. compounds such as sulfur, which prevent welding can increase the scuffing resistance of an oil appreciably.

A test which we have used for scuffing is a modified CRC 12 test which is an engine test of three hours and twenty minutes duration. A special combustion chamber is used which concentrates the flame on one side of the cylinder wall. Test severity is changed by changing the rate of fuel input or the jacket temperature. Figure 1. shows the effect of some factors on scuffing as measured by this test. In the first chart we see the effect of an addition of sulfurized sperm oil to a lubrication oil. The load which can be carried without scuffing has been definitely increased by use of the sulfur. In the second chart we see the effect of ring face finish. The turned face ring has passed at a load several steps higher than the lapped face ring will carry. Scuffing is much less of a problem with narrow compression rings than with wide compression rings.

Surface Disintegration: A third type of failure which can occur is that which Payne and Joachim in their paper called "surface disintegration." Their paper deserves very careful study by anyone interested in cylinder wear. Apparently stresses sufficient to cause removal of the metal from the surface occur without rupturing of the oil film.

Abrasive wear: On well recognized problem is wear caused by abrasive entering from either the top or the botom of the cylinder. The usual case is abrasive material entering with the intake air. We do find cases, however, in which the abrasive has entered the crankcase and is brought into the cylinder from the bottom with the lubricating oil. The best protection against this type of wear is, of course, good air filters and oil filters. Abrasive wear is essentially the same problem as the wear by mechanical action we first discussed. In the wear by mechanical action we expect, and usually find, that the harder material cuts the softer material. When abrasive is brought into the engine we sometimes find that the abrasive embeds in the softer material and actually increases the wear rate of the harder material more than that of the softer material.

Fig. 2 shows some wear profiles of cylinders which have been run under various conditions.

Fig. 7

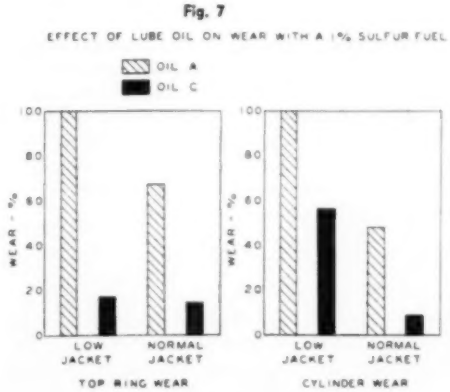
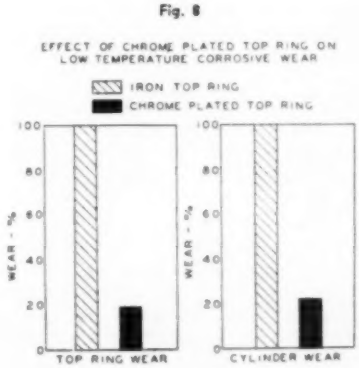


Fig. 8



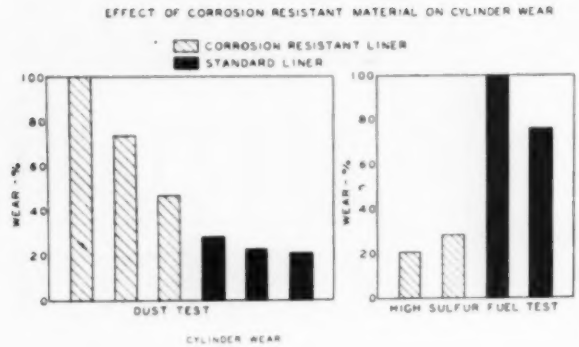


Fig. 9 (above left)

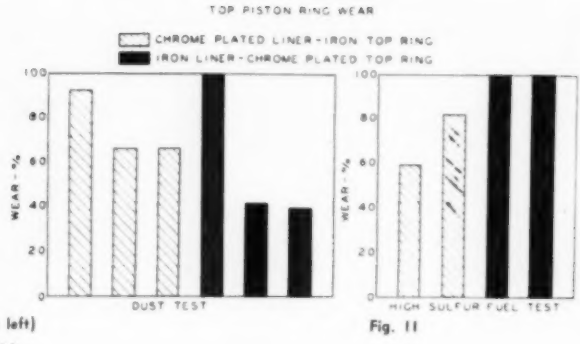
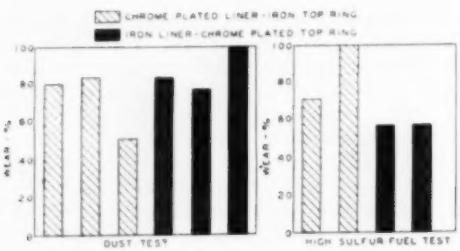


Fig. 11

Fig. 10 (left)



The profiles are similar except for the case where abrasive enters with the lubricating oil. In this case, a definite wear step is obtained at the bottom of ring travel and the wear step at the top is nearly as great as in the case of abrasives entering from the top of the cylinder. Another difference which is found is that when abrasive material enters from the top of the cylinder we can obtain very high wear of the piston rings and cylinder liner without very much wear of other engine parts. When the abrasive material is carried in the lubricant we find a very high wear rate of parts which the lubricating oil reaches.

Figure 3 shows the effect of the source of the abrasive on the relative wear rates of the various rings and the cylinder. In each case of wear the top piston ring is taken as 100% (all of the piston rings are cast iron). When dust enters with the intake air the wear of the top piston ring is about 3 to 5 times as great as the second and third compression ring wear and 25 to 50% greater than the oil ring wear. When abrasive material enters from the bottom of the cylinder with the lubricant we find the wear of all the compression rings to be about equal and the oil ring wear is about 4 times as great as the compression ring wear.

Figure 4 shows the effect of a hard chromium plated top compression ring on piston ring and cylinder wear when abrasive material enters with the intake air. This test was run in a split 6 cylinder engine—three cylinders had chromium plated top compression rings while the other three had unplated cast iron top compression rings. In running this test, dust was fed at a constant rate to the engine oil bath air cleaner.

A very marked reduction in both top compression ring and cylinder wear is found when the chromium plated ring is used.

Corrosion: One of the first and best discussions of wear caused by corrosion in engines was given by Ricardo in 1933. That it can be and is a problem under many conditions cannot be ignored.

The principal factors influencing corrosion in diesel engines seems to be sulfur in the fuel and low temperature operation. Sulfur can cause high wear rates under both high and low temperature conditions and low temperature operation accelerates wear, particularly cylinder wear, with and without sulfur.

Figure 5 gives some rather interesting cylinder wear patterns. In both of these cases a 1% sulfur fuel was used and the same lubricating oil. The jacket temperature was held at 100°F. The cylinder temperature was measured at 8 points around the cylinder with thermocouples opposite the top of top ring travel and 1/16" from the inner wall. The diagram at the left is typical of the wear pattern obtained on this engine operating under these conditions. Similar patterns have been obtained on a large number of tests.

It was known from previous work that if we reversed the piston in the engine, no effect on performance could be found until a high load was reached, but that the temperature distribution was radically changed. This is caused by the fact that the combustion space is located off center in the piston. The diagram at the right shows the temperature and wear pattern obtained when the piston is reversed. Both have been shifted and the high wear region is again in the low temperature region.

Figure 6 shows the wear pattern obtained on the same engine at a high jacket temperature with a high sulfur fuel, but with a different lubricating oil. Not all the wear patterns obtained at normal temperatures are this uniform, but they are more uniform than those obtained at low temperatures. It will be remembered from figure 3 that essentially the same vertical wear profile is obtained with high sulfur fuel at both high and low temperatures.

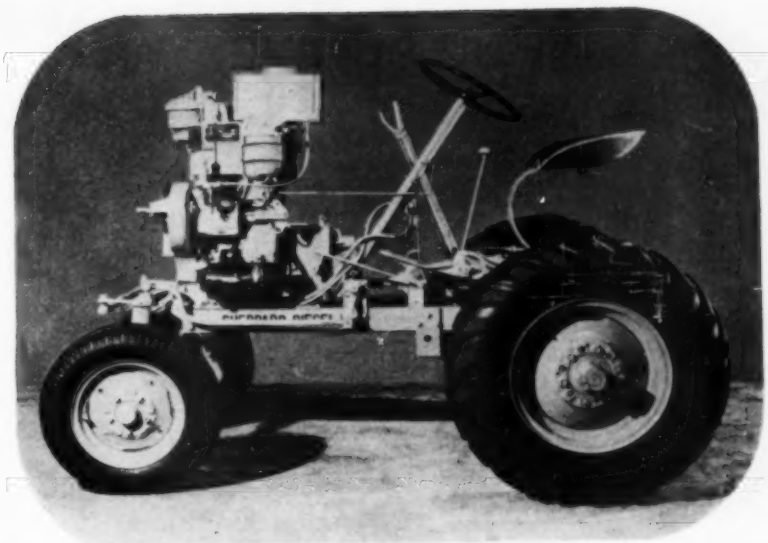
Figure 7 shows the effects of the lubricating oil on the wear obtained with a high sulfur fuel. Consider first the results obtained with oil A. When the jacket temperature is lowered from 175° F. to 100° F. the cylinder wear is doubled and the ring wear is increased about 50%. When oil C is used the cylinder and piston ring wear at normal jacket is about one-fifth as great as with oil A. At low jacket temperature the ring wear remains at about the same level as at normal jacket temperature while the cylinder wear is about five times as great as at normal jacket temperature. Oil C drastically reduces the cylinder and piston ring wear at normal jacket temperature and reduces the piston ring wear at low jacket temperature. The actual amount of increase in cylinder wear between normal and low jacket temperature is just about the same with oil C as without oil A. We would explain this as follows: The wear of the cylinder and piston rings caused by high sulfur fuels when the cylinder wall temperatures are above the dew point is caused by the SO_3 formed in burning the sulfur attacking the lubricating oil and the cylinder surface at this point. Oil A does not have sufficient ability to neutralize the SO_3 so that the cylinder and ring surfaces can be attacked. Oil C is able to neutralize the SO_3. When the cylinder wall temperature is below the dew point the condensed H_2SO_4 can attack the exposed cylinder surface since the surface is scraped almost clean of lubricating oil at the top end. The piston ring is rather well protected by oil, so that oil C is able to neutralize the acid before it reaches the ring surface and thus protects the ring surface from attack by these corrosive elements.

Summary: These then are the principal processes by which we know wear can be caused. Many factors, other than those listed influence these processes and possibly (for example in the case of surface disintegration) we may be putting more than one process under a common heading due to lack of detailed knowledge. In our experience, however, these are the important factors and processes in practical cylinder and ring wear problems.

Other than a general correlation with scuffing we have found no effect of oil consumption on wear. Oil consumption is, in itself, a rather poor indicator of proper lubrication. The oil which is being burned is not doing any lubricating. In many cases it is possible to reduce oil consumption and reduce scuffing at the same time.

We have tried to present the subject of piston ring and cylinder wear in diesel engines as we understand it today. By determining more accurately just what processes are taking place on the piston ring and cylinder surfaces we will be able to use to greater advantage the help the chemists and metallurgists can give us in combating wear in diesel engines.

SHEPPARD ANNOUNCES DIESEL TRACTORS



Sheppard SD-1, one-plow tractor, powered with single cylinder air-cooled diesel.

The Model SD-3 Sheppard, 3-plow tractor embodies interesting features described herewith.

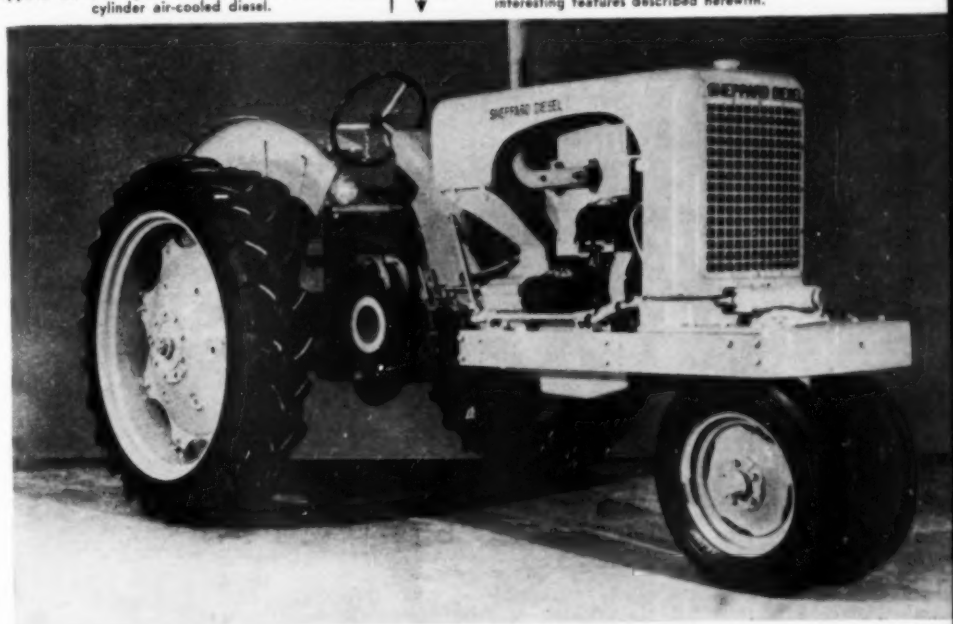
R. H. SHEPPARD CO. has been developing a line of farm tractors in three sizes since 1939. Consisting of 1, 2 and 3-plow units and designated as Models SD-1, SD-2 and SD-3, the line was first shown to the public at the recent Farm Show in Harrisburg, Pennsylvania. The result of exhaustive design, research and field tests, these new Sheppard farm tractors feature a live power take-off which is a constant source of power completely independent of the motion of the tractor, a hydraulic lift system enabling users to mount Ford, Ferguson or other lines of implements using the three-point suspension principle, electric push-button starting, and adjustable wheels.

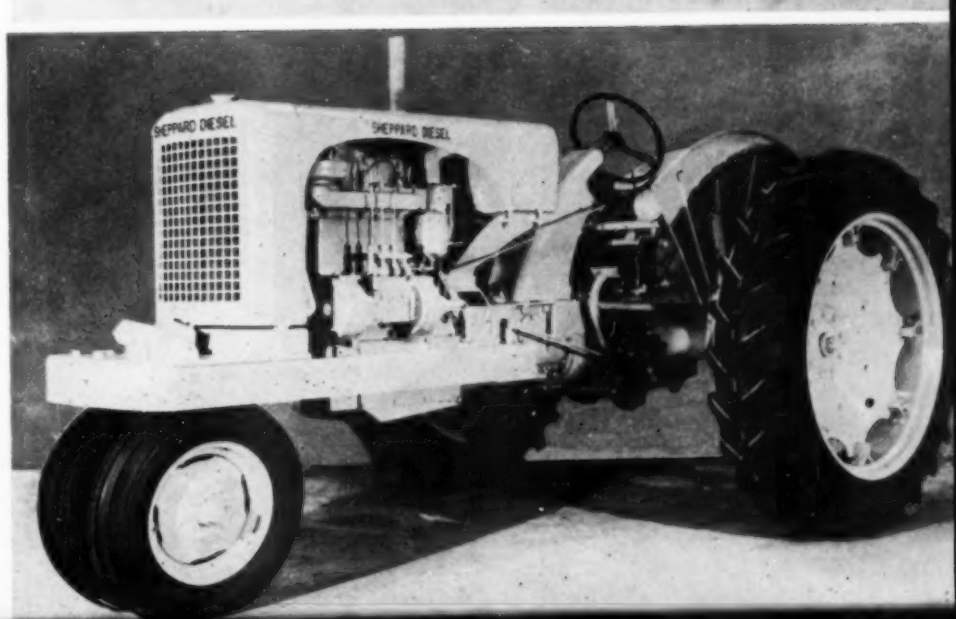
The Model SD-1 tractor is powered with the Sheppard single cylinder air-cooled diesel equipped with a manifold pre-heater element to assist in cold weather starting. This machine consumed 1½ gal. of domestic furnace oil per hour in field tests. It is a one-plow unit.

Model SD-2 is fitted with the Sheppard two-cyl. diesel and embodies all of the special features mentioned above. A standard 4-speed transmission gives this unit a range of speeds from 2.7 mph. to 10.7 mph. and there is available an auxiliary transmission which gives a top speed of 15 mph. This is a two 14 in. bottom implement, also featuring a Rockwood belt pulley that can be mounted on either side of the tractor. The belt rating is 24 hp.

The SD-3 is a three 14 in. bottom tractor, powered by the Sheppard 3-cyl. diesel and other than in size, differs from the other two models in that it has electric starting only, that is, no emergency hand starting is provided. The Rockwood belt pulley on this model is rated 32 hp. on the belt.

To be distributed through dealers here and abroad, these new Sheppard tractors have been designed so that they may be serviced by the average mechanic using the tools he would normally have on hand in his shop.

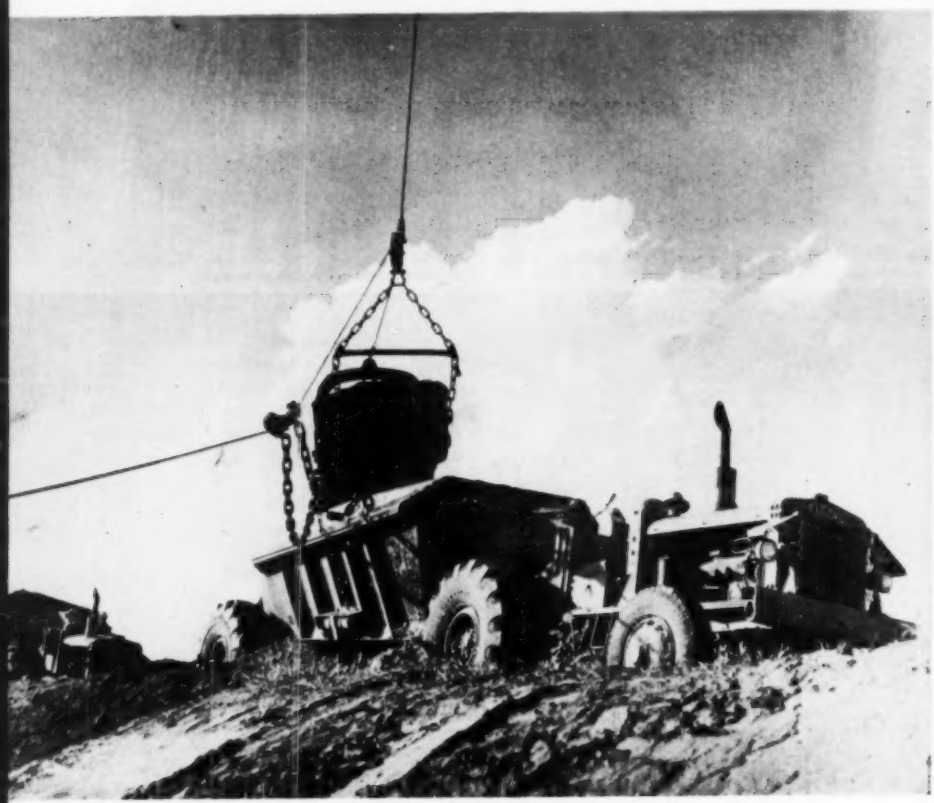




Powered by the Sheppard 2-cylinder diesel, this Model SD-2 tractor is a two 14 in. bottom machine.

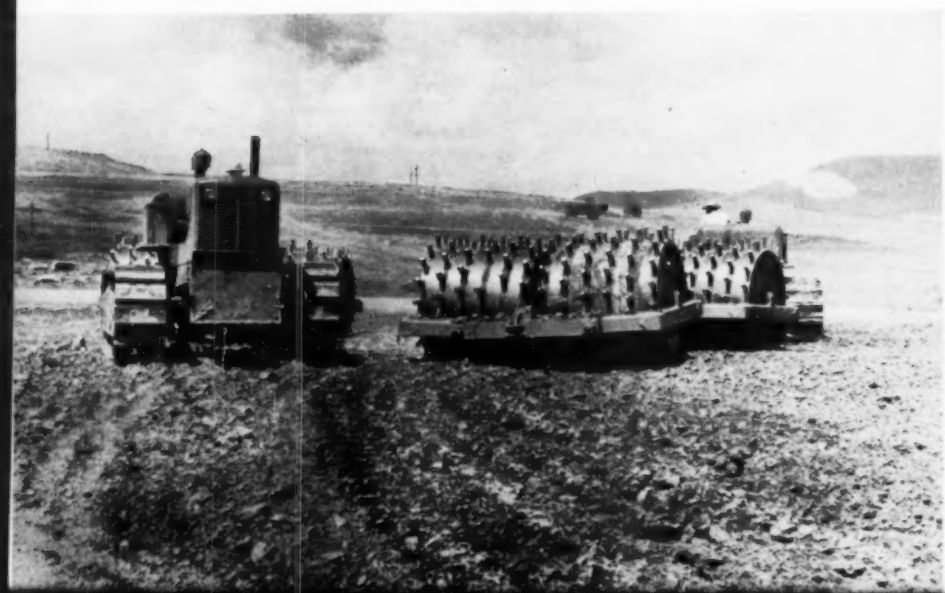
DIESELS BUILD GARRISON DAM

EARTH MOVING equipment on a grand scale is being employed in the construction of Garrison Dam on the Missouri River, 72 miles northeast of Bismarck, North Dakota. The mammoth structure is being erected by the Corps of Engineers, Department of the Army, and will become the largest earth rolled dam in the world. When completed, the 2¼ mile long Garrison Dam will measure almost 2600 ft. thick at the base and will graduate to a 60 ft. crest width. It is to be a major unit in a vast flood control and water development program for the mighty and unpredictable Missouri. When the last truck places its load of earth on thee huge fill, over 70,000,000 cu. yds. of material will have been hauled to form an embankment 210 ft. high and over 2 miles long with a base width of nearly half-a-mile. The upstream reservoir created by the captured waters of the Missouri River will cover an area of approximately 390,000 acres and extend for 200 miles to a point just below the mouth of the Yellowstone River. More than one third of the drainage area of the Missouri River is above the dam site so that Garrison Dam will control nearly one third of the total volume of flow at the confluence of the Missouri and the Mississippi.



▲ Diesel powered Euclid loader on the Garrison Dam job.

Allis Chalmers tractors powered by 163 hp. 6-cyl. General Motors diesels, each pulling 2 sets of giant Southwest sheepsfoot rollers. ↓



The Garrison Dam and Reservoir constitute a multi-purpose project specifically designed for the realization of seven beneficial objectives.

1. Provision for flood control along the Missouri River and regulation of the two high water periods, March and June, to minimize flood destruction.

2. Improvement in navigation along the Missouri and Mississippi Rivers by providing additional flow from impounded waters during dry low water seasons.

3. Provision for irrigating waters in the Dakotas.

4. Initial installation of a 128,000 kw. hydroelectric power plant.

5. Allowance for diversion of waters eastwardly to Devils Lake and James River basin regions.

6. Maintenance of a minimum low water flow on the lower Missouri River in the interests of sanitation and the stabilization of municipal water supplies.

7. Provision for recreational facilities and wildlife preservation.

Although ideas for harnessing the Upper Missouri River have been under consideration of the Corps of Engineers since the turn of the century, it was not until 1944 when Congress passed the Flood Control Act that active construction work on Garrison Dam was given the green light.

Work on Stage I of the embankment project, involving the excavation and placing of some 14,000,000 cu. yds. of carefully selected materials, has been in progress since September, 1947. The veritable army of diesel powered trucks, tractors and excavators and other miscellaneous pieces of machinery operated by Garrison Builders, Inc., on this part of the undertaking is rolling in high gear. During the latter part of the 1948 season production was at the 60,000 cu. yd. a day mark. The Stage I contract calls for excavation of the inlet channel approach, power house site and a section of core trench. Also specified are the construction of two water release tunnels for test purposes. It is anticipated that Garrison Builders will complete the Stage I contract during the latter part of 1949.

As new contracts are awarded for other stages of the project, hundreds of additional pieces of equipment will be thrown into it.

W. B. Miller, Secretary and project manager for Garrison Builders, Inc.

Eight GM diesel powered Euclid bottom dump trucks teamed with this Euclid loader and Allis Chalmers tractor have put as much as 631 loads of select impervious material on the embankment fill in 10½ hours.

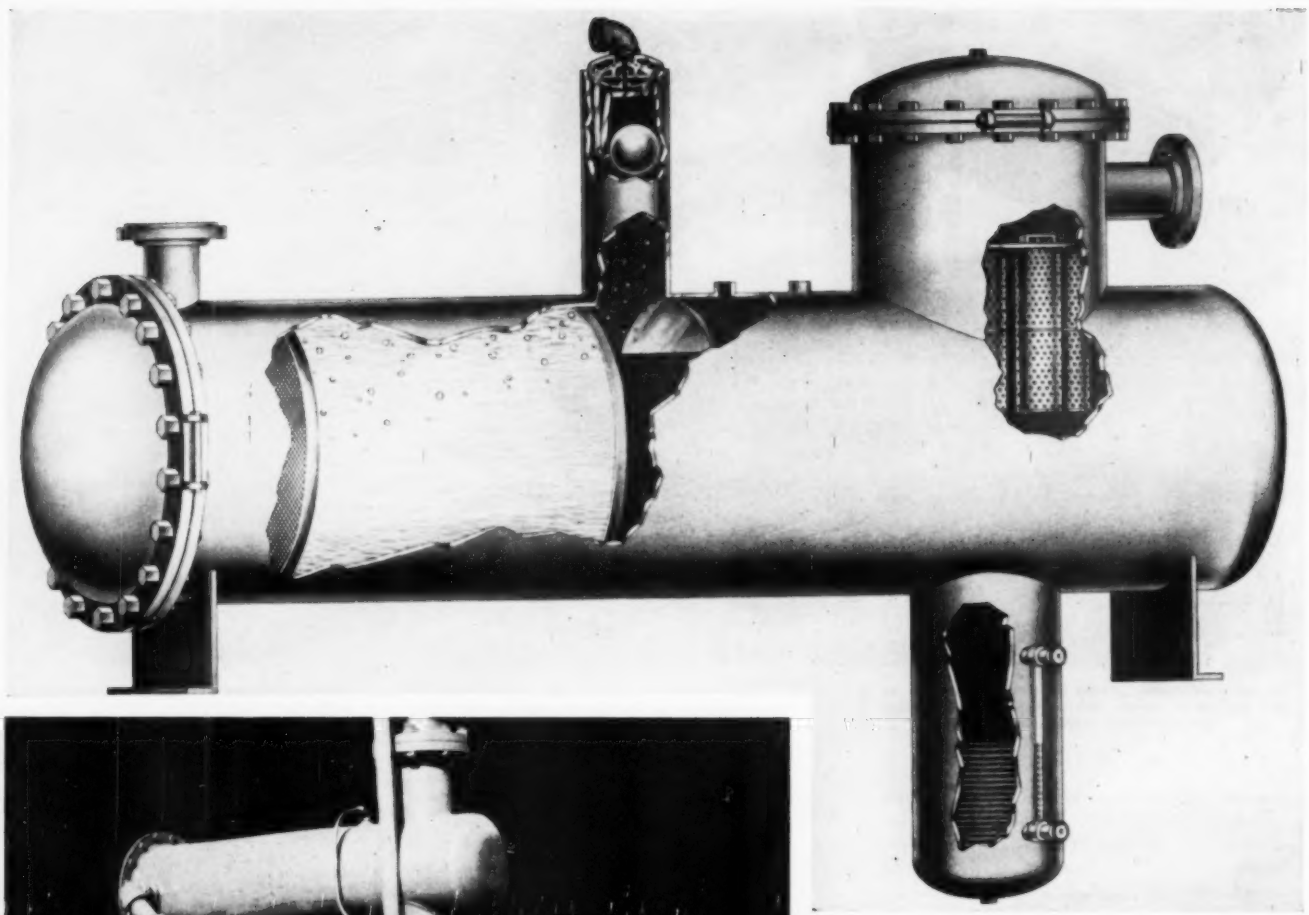
In the short period between shifts water, fuel and oil are checked in Garrison Builders fleet of 37 GM diesel powered Euclid bottom dump trucks.

Four heavily loaded Euclid bottom dump trucks approach the Garrison embankment. Approximately 11,000,000 cu. yds. of earth will be placed on the main structure during Stage I.

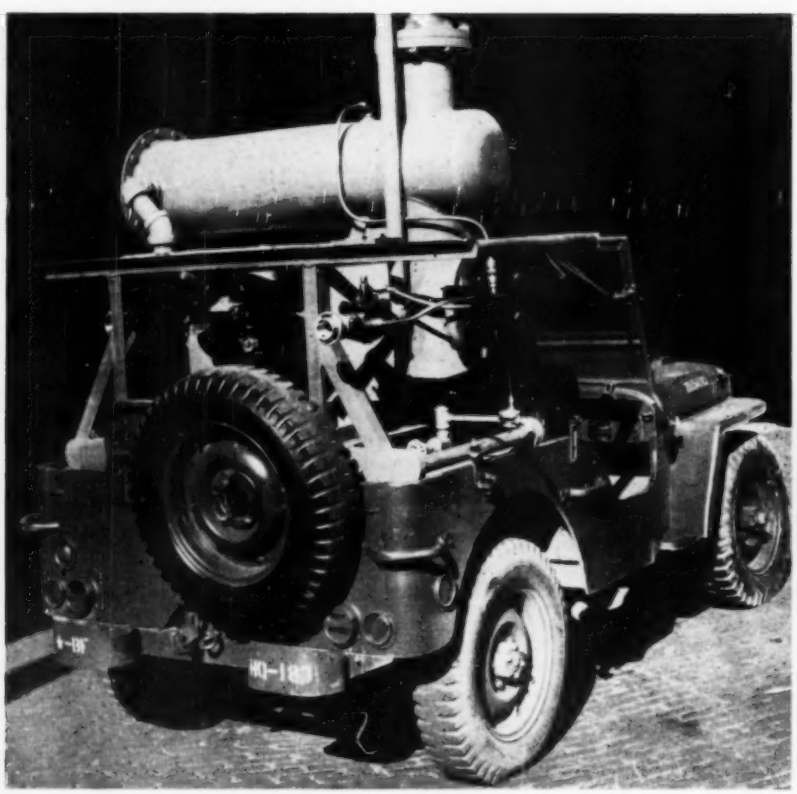
Current estimates place the cost of Garrison Dam at over $170,000,000 and depending upon the continuance of adequate Congressional appropriations, seven to ten years will be required for completion. The panoramic view of Garrison Dam site shows embankment progress after one year of construction work. This picture was taken from the bluffs on the west side of the Missouri River. The government town of Riverdale is situated on the east bluff.

Panoramic view of Garrison Dam.

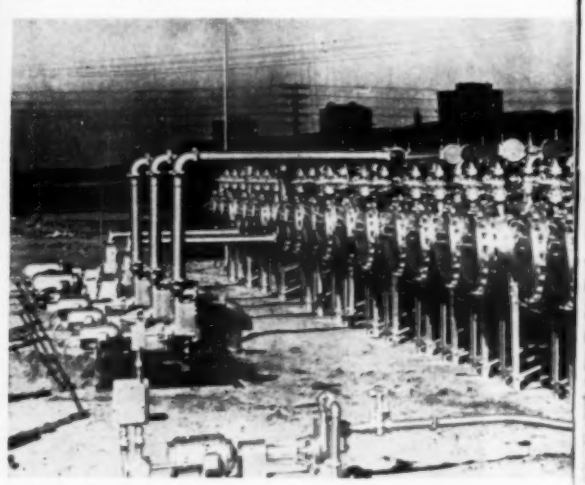
TAKE WATER OUT OF FUEL . . .



This photograph indicates the construction of the Model "FE" Excel-So Separator Filter. Note the air eliminator.



This is a mobile 80 GPM Excel-So Separator/Filter, complete with pumping unit, equipped with air eliminator.



OR ELSE!

By REX W. WADMAN

As THE density of diesel engine use increases, as more and more railroads establish central maintenance shops for their diesel equipment, as diesel bus fleets become large enough to warrant their own maintenance shops, as diesel truck fleets do likewise, the installation of special equipment for efficient maintenance work increases in importance and in ingenuity.

The maintenance engineers of these railroads, bus operators, truck fleets, etc. quickly recognized the needs for removing contaminants from the fuel. In order to obtain maximum efficiency and long engine life with a minimum of maintenance, the petroleum refiner has long recognized this obligation to guard against contamination of his products between the refiner and the consumer outlets. As a result, development work in the field of filtration accelerated. It was found that abrasive particles, five or more microns in size, created excessive wear between moving surfaces.

In my work in the oil industry I have run into a number of installations of a combination water separator and micronic filter manufactured by the Warner Lewis Company and I am inclined to believe that this unit can be adapted to our industry in places where a large volume of fuel is stored and used.

This Warner Lewis unit works on the basis of removing water from the fuel by means of a special coalescing media which is solvent-treated to prevent contamination of the fuel. The water found in fuel ranges from free water to droplets which are so small and widely dispersed that they resemble a fog. The individual particles are beyond the range of a human eye and frequently measure less than 5 microns in diameter. These minute particles are brought into contact by the coalescing media and grow to a size where they are separated readily by gravity. The separation is expedited by means of coalescing and impact baffles. The coalescing media is packed to a high density and makes an excellent volume-type filter. Several large products pipe line companies use these units, in lieu of conventional wire and felt strainers, for their filtering ability only, since, being of the volume type, they will remove and hold infinitely more contaminant than the usual surface-type filters.

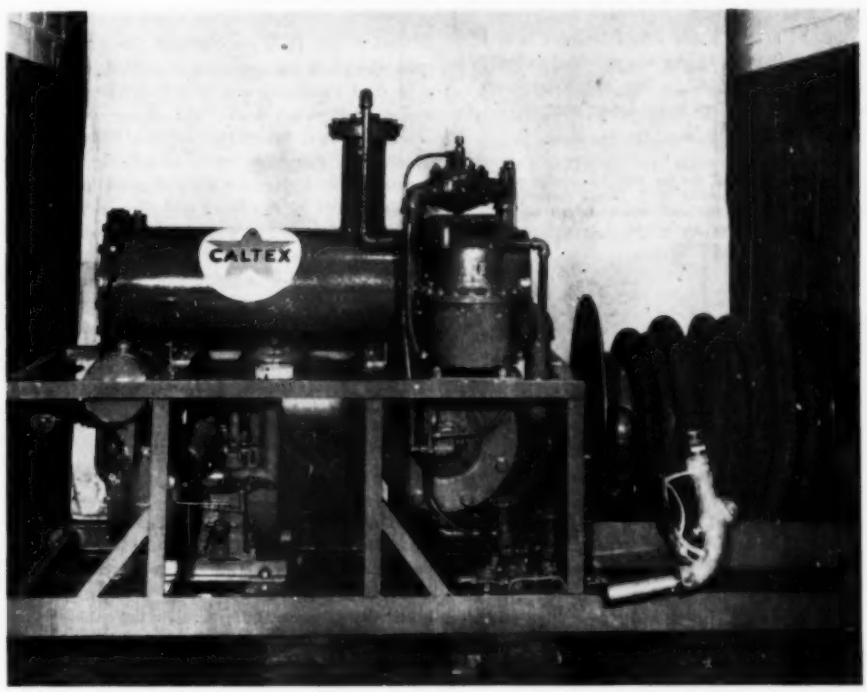
Substantially all of the solid contaminant larger than 5 microns are removed by means of a plurality of special resin-impregnated paper-type filter elements in the first models of the combination water separator and micronic filters. However, in its present state of development, almost all of the contaminant is removed in the coalescing media and the paper filter elements are used to polish the fuel only. Since the solid contaminant is preferentially water-wetted and has a higher density than the fuel, it was possible to design the unit so that the solids followed the water and separated from the stream. The result is a water separator and filter which separates both water and contaminant and dumps them as fast as they are removed from the fuel.

The Combination Water Separator and Micronic Filters can be equipped not only to dump the water automatically but also stop the flow of fuel in the event a large slug of free water enters the system. When this occurs, the units eliminate all of the water and then resume the flow. All operations are automatic and no supervision is required during operation. Due to the noticeable absence of moving parts, maintenance cost is substantially negligible and the total operating cost seldom exceeds 0.02 mil per barrel.

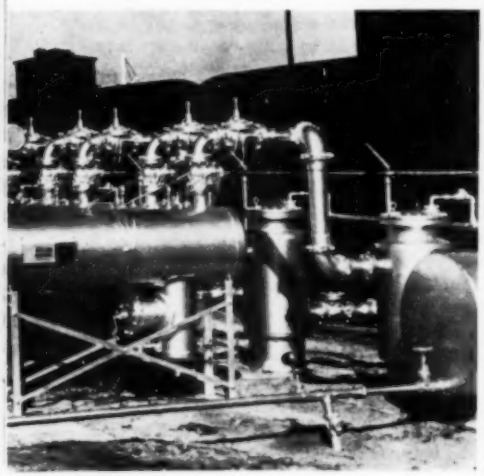
The Combination Water Separator and Micronic Filter is built in capacities ranging from 10 to 500 gpm. and in conformance with the various Codes up to 600 lbs. working pressure. A similar type unit is built for water separation only and does not contain the paper-type micronic filter elements. These units are built in capacities ranging from 10 to 1,250 gpm. and for working pressures up to 1,000 lbs. It is interesting to note that the units can be equipped with an air eliminator mechanism, thus eliminating an extra piece of equipment.

The illustrations herewith are, generally speaking, of equipment supplied for the petroleum industry but the principle seems to be very practical for us in this diesel industry. As a matter of fact, the Santa Fe Railroad is already using two of them and I would not be a bit surprised if the use of this combination water separator and micronic filter spreads rapidly through the maintenance end of our industry. It looks to me like a useful contribution to the art.

Cal-Tex portable unit complete with self-priming, centrifugal pump, air eliminator (built into Separator), hydraulic slug-control valve, positive displacement meter, and hose reel. →



Esso Standard Oil Co. installation at Morehead City, N. C. These 18 HP-300C Excel-So Separators are used to remove water and debris from finished products ranging from Aviation Gasoline to Heating Oil. ↓



POWER FOR PARIS, KENTUCKY

By WM. H. GOTTLIEB

IN HUNDREDS of communities, municipal power plants have assumed much broader functions than the basic task of supplying economical and dependable electric power. The economies of local power generation with efficient diesel engines together with the profits of municipal distribution and sale of electricity usually provide a substantial cash reserve. Most towns seek to return at least part of the profits to the consumer through reductions in lighting rates but frequently this merely encourages greater consumption of electricity and pours still more profit into the city coffers. Many municipalities use power plant profits for civic improvement which otherwise could come only through borrowing and higher taxes on the people.

Paris, Kentucky, affords an excellent example of the important place a diesel plant can play in community life. In 14 years of operation with Fairbanks-Morse diesel engines, the municipal power system has amassed a total net profit of $350,389.59. Of this sum, $212,634.79 has been contributed to the city and $137,754.80 remains in the surplus account. The dollar sign has lost much of its meaning in these days of multi-billion budgets, so let us see in more concrete terms what $350,000 means in the life of a city of 6,700 population in Kentucky.

First, the city and the Chamber of Commerce matched funds to build two factories to attract industry to the community. These plants already employ 400 persons with 150 more employees to be added in the near future. Light plant profits also helped finance a new school building, a hospital and a library. Money was provided to build three concrete bridges, to buy a fire truck, to build a playground, to buy a street sweeper. An historic building was purchased and turned over to the D.A.R. for maintenance. Funds were advanced to bring an American Legion convention to town. The balance went to improve city services and keep taxes low.

All these contributions, of course, were in addition to the plant's basic job, the provision of cheap, dependable power. A dependable power source is vital to a modern city like Paris. It is needed at the Liggett and Meyers tobacco redrying plant where they process tobacco for Chesterfield cigarettes. It is essential for operation of the grass seed stripping plant which prepares Kentucky blue grass for world markets. It is needed out at the Hancock Stud Farm where Gallant Fox and other famous thorobred horses are stabled. In all, it means power for 31 industrial users. It means business for 268 retail stores. It means light, heat, power and refrigeration in 1,231 homes.

The diesel record in Paris is unblemished. Not once in 14 years has there been an interruption of service due to engine failure. During this time, Paris' diesels ran a total of 141,955 engine hours. The No. 3 engine, installed in 1934, had operated 59,041 hours by the end of 1947. In 1947, this unit was at work 7,329 hours out of a possible 8,760, more than 83.6 percent of the time.

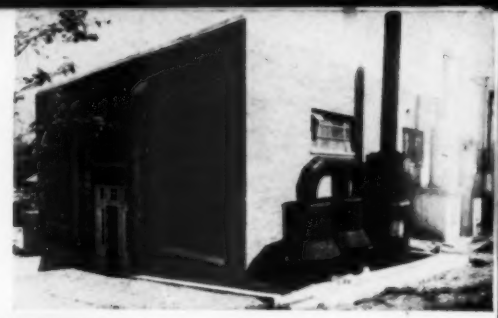
City officials reduced electric rates shortly after the plant went into operation and have maintained a competitive position with relation to the private utilities. Moderate rates and large profits inevitably stem from low operating costs. In 14 years, the plant has produced 45,466,416 kw. hrs. at a total operating cost of $394,270.10, which means $0.0086 per kwh. This figure includes superintendence, labor, fuel oil, lubricating oil, maintenance, supplies, and miscellaneous expenses. Table I gives a picture of operations for the entire life of the plant with annual figures for kwh. generated, fuel and lube consumed, peak loads, production cost, and net profit. It shows how the plant grew steadily from year to year with a phenomenal spurt in the post-war period when the load more than doubled. Fuel consumption for the past few years has been well over 11 kwh. per gal. It should be noted that the net profit is figured after all expenses of generation, sales, and distribution, including interest and depreciation on equipment at 5 percent per annum.

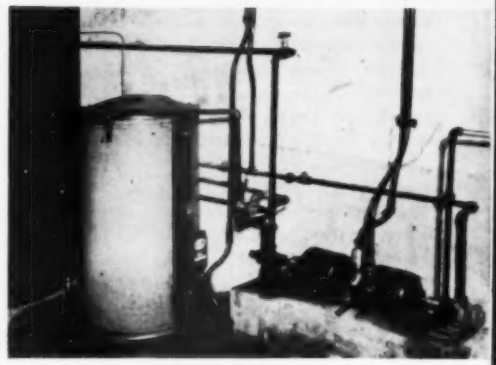
Economy and dependability were engineered into this plant. At the outset, the engines chosen were Fairbanks-Morse Model 33 diesels, heavy-duty pump-scavenging units with full pressure lubrication and oil-cooled pistons. The first two engines, installed in October 1933, were 5-cylinder, 14 x 17 in. units, rated at 525 hp. at 300 rpm. Each was direct-connected to a 357.6 kw. Fairbanks-Morse alternator with 13 kw. direct-driven exciter. A few months later, a Model 33D16 F-M diesel was installed, a 6 cyl. unit of 16 in. bore and 20 in. stroke delivering 1050 hp. at 300 rpm. This engine was connected directly to a 731 kw. F-M alternator. The 15 kw. exciter is driven by a 25 horsepower motor.

These three diesels carried the entire load for more than 13 years. For eight of these years, it was necessary to have the big No. 3 engine in operation to handle the peak loads. The engines were always ready for service when needed. All three are in full operation today, functioning with undiminished efficiency. On the city's books, more than 70 percent of the value of these diesels has been written off as depreciation, but there is no depreciation in actual performance.

Paris engineers recognize that it is not desirable to let peak loads come so close to plant capacity and, as soon as new engines became available after the war, put in an order for another, larger unit. This was a 7 cyl. Model 33F16 Fairbanks-Morse diesel rated at 1400 hp. at 300 rpm. with a direct-connected 980 kw. F-M alternator and V-belted 20 kw. exciter. Installed in 1947, this engine brought plant capacity to 3,500 hp., but the peak load jumped in a single year from 1180 kw. to 2080 kw. and Paris found itself in the position of needing three of its four engines, including the two big ones, to carry the load. The answer, of course, is the installation of a fifth diesel, already on order.

To insure trouble-free operation, Paris provided good protective accessories for its diesels. Only soft rain water is introduced into the engine circuit of the closed cooling water system. The three older units are hooked together with three motor-





TOP: exterior view of the Paris power plant shows the American Air Filters and the Maxim intake and exhaust silencers.
Lubricating oil for the 1400 hp. Fairbanks-Morse Diesel is cleaned continuously during operation by a Honan-Crane purifier.

A separate alarm panel for the 1400 hp. engine carries an Alnor exhaust pyrometer, U. S. Gauge thermometers and pressure gauges, and push-button controls for auxiliary equipment.

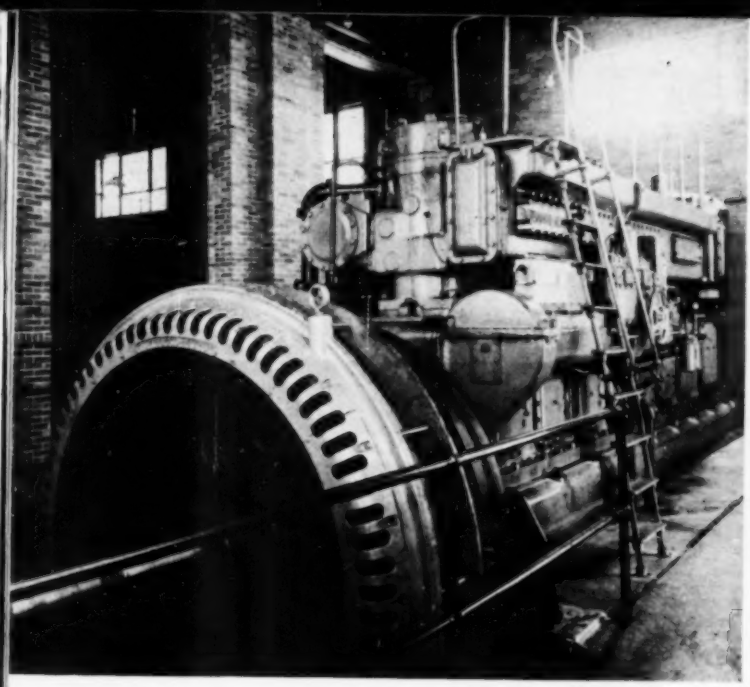


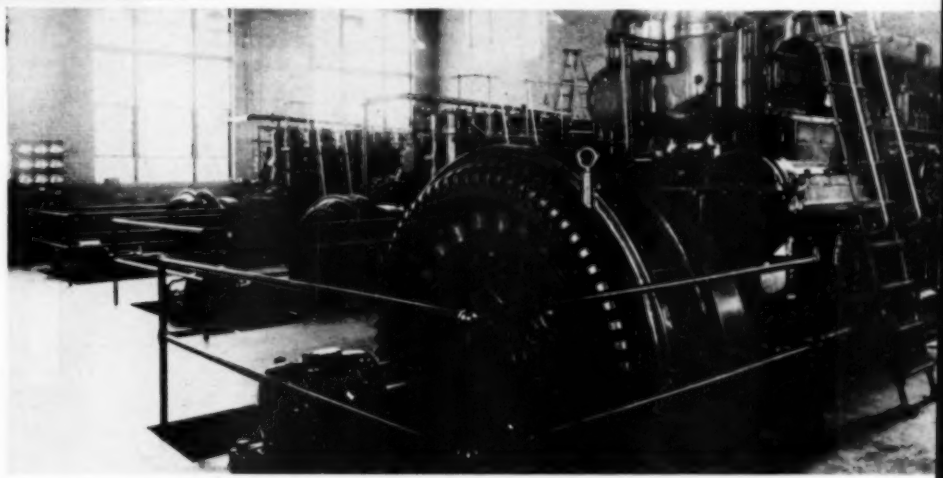
TABLE I.

14-Year Diesel Operating Record--Paris, Kentucky

Year	Kw. Hrs. Generated	Lube used Gal.	Fuel used Gal.	KwHrs. Per Gal. Fuel	Peak Load	Total Production cost	Net Profit
1934	1880000	4590	189380	9.45	503	20,341.85	23,961.16
1935	2207610	2741	209291	10.55	539	19,188.99	15,354.55
1936	2326410	3067	216886	10.73	572	20,357.08	12,963.76
1937	2767855	3111	250156	11.06	646	23,087.41	12,991.05
1938	2842665	3766	258005	11.01	720	23,032.06	23,077.22
1939	2781000	3902	258190	10.77	805	21,316.25	23,504.89
1940	3198025	4580	288690	11.06	840	22,723.61	29,150.12
1941	3295626	4973	305700	10.78	850	25,534.71	28,554.31
1942	3316975	5539	307670	10.78	850	28,085.56	22,799.77
1943	3493400	5537	319720	10.92	850	29,980.92	26,227.99
1944	3598450	6059	332670	10.78	880	31,480.65	26,976.68
1945	3744525	5480	325900	11.49	995	31,514.52	34,387.82
1946	4406875	5923	392240	11.23	1180	37,894.74	39,337.11
1947	5616000	6957	493110	11.38	2080	39,791.94	31,163.16
	45,466,416	66095	4147608			394270.10	350389.59

These three Fairbanks-Morse Diesels have been in operation in the Paris, Ky., power plant for more than 14 years, running a total of more than 140,000 engine hours.

Newest engine in the Paris, Ky., municipal power plant is this 1400 hp. Model 33F16 Fairbanks-Morse Diesel which drives directly a 980 kw. F-M alternator. Also visible are the Woodward governor and the duplex Nugent fuel filter.



driven F-M centrifugal pumps circulating the soft water through the engine jackets and two Schutte & Koerting heat exchangers. A 6000 gal. hot well in the circuit adds a safety factor and minimizes fluctuation of water temperature. Two of the three pumps operate together with the third as a standby. Raw water for this system is drawn from a nearby stream, pumped through the exchangers and returned to the stream. A pair of Fairbanks-Morse centrifugal pumps driven by 15 hp. F-M motors are alternated every two weeks. There is an emergency connection between the closed circuit and the city water mains but it has never been used.

A completely automatic cooling system serves the No. 4 diesel. Engine jacket water is circulated by a motor-driven 5 in. F-M centrifugal pump through a Fairbanks-Morse evaporative cooler. Another set of pipes carries lubricating oil through the cooler. Modulating shutters, operated automatically by Minneapolis-Honeywell thermostatic controls, regulate the quantity of air drawn in by the cooler fans and keep temperatures at the desired level. Lube oil for the other three diesel engines is cooled in individual Schutte & Koerting oil coolers.

Texaco Algol is used as the lubricant throughout the plant and Superintendent Edgar Dodge reports that they have never had a stuck ring. In 14 years, the connecting rod bearings have been taken up a maximum of .003 in. Lube for the three older engines is centrifuged with a Hydroil in continuous operation on scraper ring oil. The latest engine has a Honan-Crane lube purifier which operates when the engine does. All the diesels have Madison-Kipp cylinder lubricators. Each engine also is provided with a motor-driven Roper auxiliary lube pump to bring up pressure before starting and to maintain lubrication and cooling for a short time after the engine operation is turned off.

Fuel, stored in two 20,000 gal. tanks above ground, flows by gravity to individual day tanks through one National and three Niagara meters. There is a filter on each engine, Zenith on Nos. 1 and 2, Nugent duplex pressure filters on Nos. 3 and 4. The quantity of fuel injected is regulated by Massey governors for the small units, Woodward relay-type governors for Nos. 3 and 4.

All intake air is filtered by American Air filters, impingement type for the first three, a Cycoil combination oil bath filter and silencer for the fourth. No. 3 also has an intake silencer. Exhaust gases vent through vertical Maxim silencers. Starting air is supplied by a pair of F-M compressors, one driven by motor, the other by a gasoline engine.

There are two alarm panels, one for the original plant and a separate panel for the No. 4 engine. Both include Alnor exhaust pyrometers and pressure gauges on scavenging air, lubricating oil and cooling water. Alarms sound if pressures go beyond prescribed limits. The No. 4 panel also has motor control buttons for the lube auxiliary pump, cooling water pump, evaporative cooler fan, and evaporative cooler pump. The 7-panel F-M switchboard is equipped with Weston voltmeters, ammeters, kw. meters and synchroscope, Duncan totaliging kwh. meters, Bristol recording voltmeter, and Roller-Smith oil circuit breakers. There is an Allis-Chalmers rocking contact voltage regulator of the Brown Boveri design for each engine installed.

The plant is well staffed with four operators working six 8-hour shifts every eight days. Pistons are pulled for inspection once a year with the regular staff handling most of the maintenance jobs. Aside from Superintendent Dodge, responsibility for plant operation is vested in City Managing Agent Boone Baldwin. A six-man utilities board supervises the power and water systems with ultimate authority resting in the hands of Mayor George Doyle and the four city commissioners.

The citizens of Paris are ever conscious of their power plant's contributions for it lends a hand in virtually every civic venture. The $137,754.80 still in the surplus account promises more dividends for the future.

AT LAST!

A Diesel Lubricant for

SHELL RESEARCH develops in ONE oil qualities which meet any combination of these conditions:

1 EXTREME HEAVY LOADS

2 CONSISTENT LIGHT LOADS

3 LOW JACKET TEMPERATURES

4 LOW-GRADE FUELS

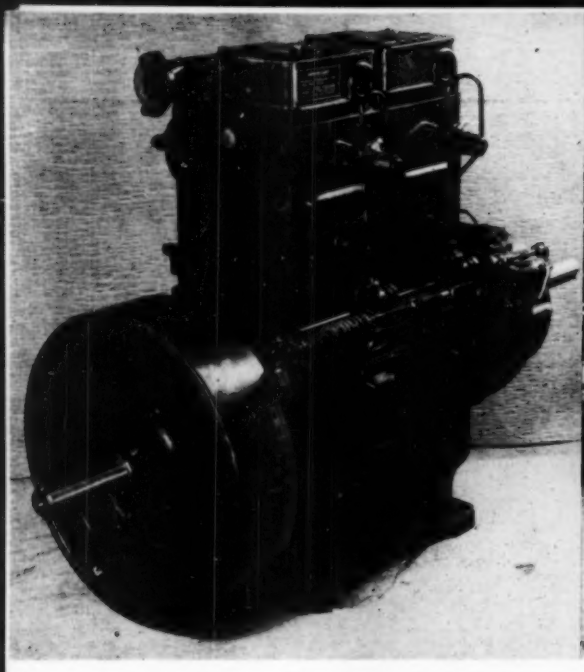
THESE CONDITIONS DEMANDED THIS NEW OIL:

DIESEL ENGINES seldom encounter ideal operating conditions. Low-grade fuels . . . wide variations in load . . . long periods of light-load operation . . . subnormal jacket temperatures . . . all are too-common conditions heretofore associated with high maintenance costs and short engine life.

You run into such trouble on many construction jobs, in pumping installations, in standby service and in marine auxiliary units . . . to name just a few. And . . . highly supercharged Diesels frequently magnify the effects of extreme operating conditions.

Shell Research scientists regarded the situation as a challenge, and went to work on an entirely new concept of Diesel lubrication. The result is Shell Rimula Oil . . . the first Diesel lubricant to effectively

For Extreme Diesel Service...



The new Crofton 2-cylinder, Model 10/2 diesel, rated 10 hp. at 1500 rpm.

Single and twin-cylinder diesels coming off the assembly line in the English plant, headed for export to the Crofton company in U.S.A.

SMALL INDUSTRIAL DIESEL

By WILL H. FULLERTON

THE Crofton Diesel Engine Company of Southern California is now offering a line of small diesel engines to the industrial markets of the United States including manufacturers of pumps, generators, cement mixers, small road rollers, light plants, plaster mixers, agricultural machinery, small tractors and material handling machinery. Having been engaged in the distribution of small diesel engines for the past fifteen years, the Crofton Diesel Engine Company recently closed a contract whereby the English Petter AV1 and AV2 engines could be offered to American industry; hence the "CROFTON" diesels 5/1 and 10/2—"Manufactured in England and merchandised in the U.S.A. as the new 'CROFTON' diesel."

The Crofton firm reports enough parts on hand to assemble the engines in this country, but due to England's mass production set-up of the engine, as can be seen by the accompanying photograph, the engines will be shipped into the U.S.A. complete and ready to run, though each one is again placed on an electric dynamometer and given further tests for horsepower ability, fuel economy and smoothness, before the Crofton Company name plate is attached.

The engine itself is of interesting design. By utilizing the conventional jerk-type fuel pump and pintle-type nozzle, as well as Ricardo type precombustion chamber, the engine is able to burn commercial diesel fuels which engines of similar size are expected to consume. This, together with a high degree of combustion efficiency, results in a clear exhaust. The engine is offered in a one cylinder, five horsepower, and two cylinder, ten horespower design, each developing its rated horsepower of five and ten respectively at 1500 revolutions per minute.

An interesting feature of this small diesel is the flexibility of power take-off. Each engine is equipped with a 1½ x 4 in. crankshaft extension on the flywheel end for either a pulley or hand crank, or both, while the opposite end of the engine is supplied with a similar stub extending from either the crankshaft or cam shaft at user's option, thus allowing either engine or half engine speed take-off on that end. As this stub is a separate piece, it can be made of steel, monel or bronze, depending upon whether it is to be utilized as pulley-shaft, corrosive liquid pump shaft, carrying the impeller of a unit mounted pump, or a salt water stuffing box for a marine application.

This same end of the engine with its alternate drive selection is designed so the Crofton Company can supply fluid drive coupling, vee belt pulley, chain sprocket, or most any other kind of drive, at either engine or half-engine speed while still giving consideration to the necessities of hand cranking. Although the Crofton Diesel Engine Company 5/1 and 10/2 models are designed and built to be hand cranked, twelve volt electrical starter and generator kit with Bendix drive to flywheel ring gear is available.

Internal design of the engine follows usual practice, inasmuch as the separate cylinder blocks incorporate wet liners and the separate detachable cylinder heads incorporate pressure feed to the rocker arms. The two cylinder engine weighs only 550 pounds and develops ten hp. at 1550 rpm.

The engine is force-feed lubricated with an eccentric strap-driven plunger type lube oil pump that pumps its own lube oil up through the strap and into the hollow crankshaft, while at the same time constantly oscillating the oil intake screen to keep it free from carbon formations.

In order to provide a high degree of interchangeability, the 5/1 and 10/2 engines all use the same heads, blocks, liners, pumps and bearings. As a matter of fact, a two cylinder crank case casting and crankshaft forging, plus parts from two one-cylinder 5/1 units, plus one extra copper lead connecting top and bottom precision shell to act as center main bearing would make a two cylinder 10/1 out of two 5/1's. Another point of interest is the interchangeability of 10/2 exhaust and intake manifolds that assures the user of the engine of being able to take the exhaust off either end of the engine at will, while keeping the oil bath air intake silencer and cleaner on the opposite end for accessibility. Interesting also is the small over-all size of the 10/2 engine. Utilizing a 15½ in. flywheel, it has a 26 in. over-all length and 28 in. height.

The Crofton Company advises it has trained service personnel, and original factory parts now available in New York, New Orleans, Seattle and San Francisco, as well as parts being offered out of San Diego, California, on an immediate delivery basis.

PRECISION BEARING INSTALLATION

By W. W. BLACK*

TODAY, most diesel engine main bearings are of the precision type. This places additional responsibility on diesel mechanics who are faced with bearing maintenance work. They must understand the principles of precision construction, be able to recognize factors which may affect precision, and must vary their working methods and tools to conform with precision requirements.

Precision construction retains its inbuilt superiority only when precision standards are observed during maintenance and repair. It is up to the mechanic to see that these standards are met. When the bearing tolerances prescribed by engineering experience are ignored, the principal purpose of precision construction is defeated. These tolerances are calculated and tested to give maximum wear with a minimum of friction.

Maintaining precision requirements demands more than good judgment and experience—it demands workmanship of far greater accuracy than can be supplied by human observation and feel. A nut may be tight, but precision demands a specific degree of tightness; a shaft may spin free, but precision demands that the clearance which permits this free motion be closely controlled. These demands are too exacting to permit guessing, and a guess that happens to "hit it on the nose" is questionable evidence of precision workmanship. The range in size of diesel engines available make over-all rules difficult to formulate. Therefore the remarks herein apply only to automotive diesel engines and power units of 200 horsepower and less. In no case are these instructions intended to supplement or alter definite operating manual specifications.

There are two important requirements which must be met to assure long bearing life: (1) proper bearing running clearance must be maintained; and (2) alignment of the main bearing bores must be accurate. Failure to meet either of these fundamental requisites may result in early bearing failure. A bearing that is too tight will tend to bind and cause friction when it gets hot; a bearing that is too loose will cause increased oil consumption due to excessive spray-off and early bearing failure due to the hammering effect. Misaligned bearing bores not only increase bearing wear, but impose continuous bending stresses on the crankshaft.

If the crankcase was a completely rigid structure, precision bearing installation would be much simplified. Unfortunately, this is not the case. Under certain conditions, crankcase distortion may be sufficient to exceed precision tolerance limits. The most common cause of crankcase distortion is careless assembly wherein parts are forced out of shape by excessive tightening of bolts, nuts, studs, etc. Controlling distortion caused by assembly is entirely within the province of the mechanic. Practically all operating manuals include torque tightness charts for various critical assemblies. When installing bearing caps, make certain that the charted torque values are used.

Mechanics who are skeptical of this advice may perform a simple experiment. Install a bearing bore alignment bar and tighten each cap bolt to specified torque requirements. If the bearing bores are aligned, the shaft should rotate freely. Next, tighten down bearing caps using torque values 10 foot-pounds above those specified. The aligning bar will rotate less freely, and in many instances will be locked. In all cases, if the bearing bores are in good condition, an additional 20 foot-pounds of torque on each cap bolt will bind the bar so it cannot be turned.

It is up to the mechanic to make certain whether or not distortion exists. Here again the aligning bar is brought into play. With all bearing caps tightened to specified torque values, the bar should slip through the bores easily with approximately .0015-inch clearance in each bore. When the bar binds, it is evident the bores are out of line. Slight distortion may be corrected with a hand scraper; more serious alignment may require use of an aligned boring machine.

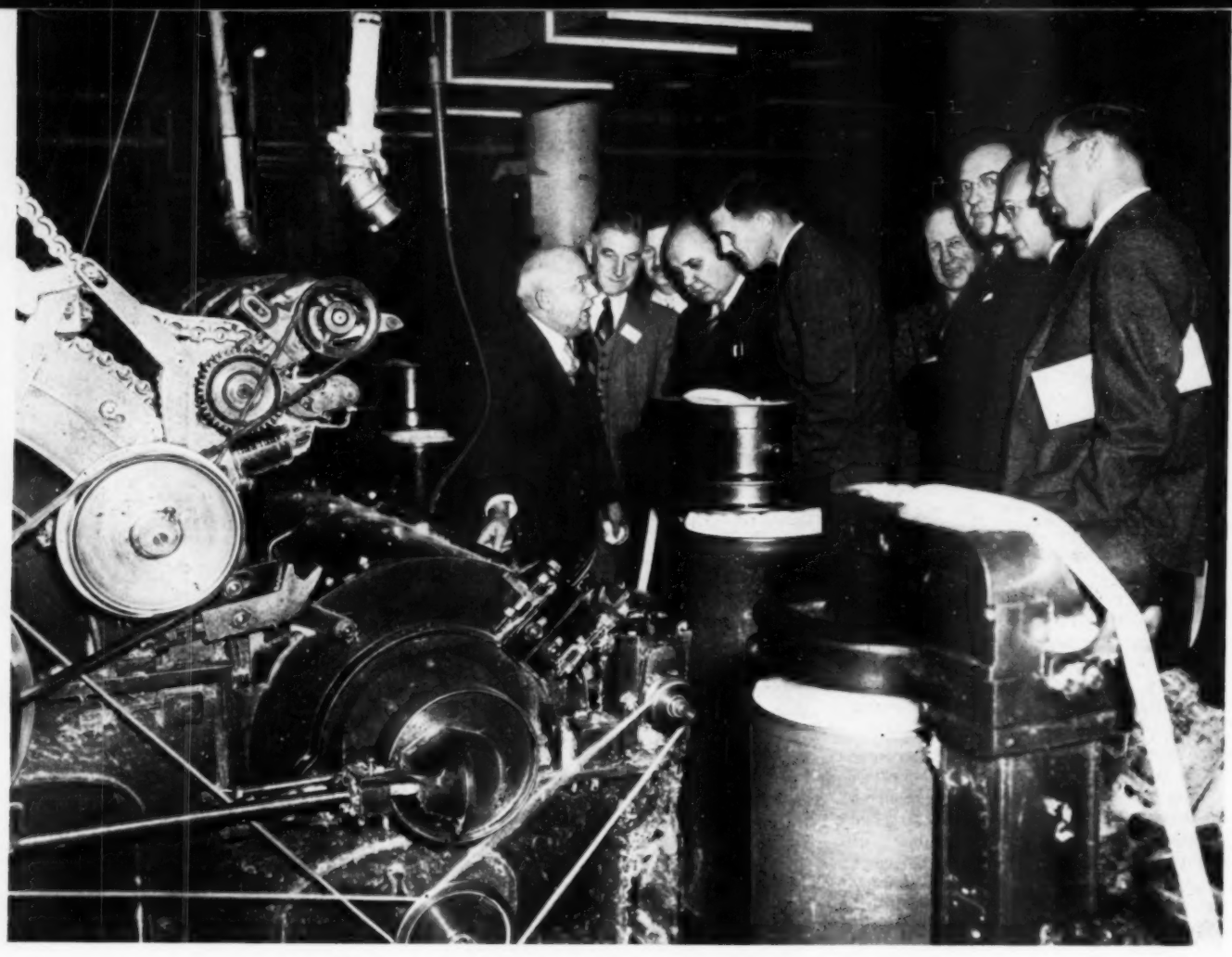
Once crankcase distortion has been checked and bearing cap torque tightness values established, installation of the bearings becomes a simple procedure. But do not assume that the bearing running clearance will be correct without a final check. To accomplish this, use a small piece of virgin lead wire, approximately .015-inch in diameter, placed under the bearing cap. Tighten the cap to a specified torque tightness, then rock the crankshaft back and forth (do not rotate it) by hand. This action will cause the lead wire to be compressed into the existing bearing clearance. Subsequent "miking" of the flattened wire will give actual running clearance. A new plastic wire is available from the Perfect Circle Piston Ring Co. which may be used in place of the virgin lead wire.

The practice of using shim stock in place of the virgin lead wire or plastic wire is not recommended. The shim employed, if too thick, will imbed itself in the bearing metal during tightening of the cap. This will result in "high spots" in the bearing metal, and will increase the danger of subsequent bearing failure.

Using a small piece of virgin lead wire (approx. .015-inch in diameter) to check clearance of bearing. After the bearing cap is tightened in place, using a torque wrench, it is removed and the compressed wire "miked" for thickness. Plastic wire is now available for this purpose.

Clean, convenient and unhampered working conditions contribute to precision maintenance. Here bearing caps are being installed in a tractor engine.

*Manager Service and Parts Dept. Industrial Power Division International Harvester Co.



Group of interested professors learn intricacies of cotton yarn processing at Commercial Filters plant.

NEW ENGLAND EDUCATIONAL CONFERENCE

THE Diesel Engine Manufacturers Association under Harvey T. Hill has been carrying on an energetic educational campaign designed to acquaint university teachers and professors with the diesel engine industry. E. L. Dahlund who joined D.E.M.A. early last fall has taken over the direction of this program and has done, with the full cooperation of the companies concerned, an excellent job of acquainting university personnel with the problems and aims of the industry. Emphasis during the past months has been upon the manufacturers of diesel engine accessory equipment. A series of programs held in various parts of the country at the plants of these accessory manufacturers has done much to increase the knowledge of those concerned.

One of the most successful meetings was held recently in New England when approximately 30 professors representing eastern universities visited the plants of the Commercial Filters Corporation of Boston and the Fram Corporation of Providence, Rhode Island. The morning session was held in Boston where the guests were introduced to the *FULFLO* filter by R. L. Fielding of the Commercial Filters Corporation. Fielding briefly outlined the importance of filters for diesel engines and gave a short history of the company's development of this type of filter. He described the Fulflo filter and told of its bleached cotton element and its construction and how it holds contaminating dirt in depth. He then pointed out that the most efficient system of filtration was a combination full flow and bypass system. This type could be operated at a lower maintenance cost than any other, he pointed out, since the life of cartridges in the combination system was nearly twice as long as when they were installed in a full flow system.

George Clemow, Commercial Filter's assistant chief engineer then described various lube and fuel oil filtering systems.

The group was then taken on a guided tour of the plant which included visits to the testing and chemical laboratories. The most interesting part of the plant was the section devoted to the processing of the cotton fibre used in the element. It is an amazing experience to see fluffy bleached cotton deftly handled by the textile machinery and come out in a perfectly spun strand ready for winding on the filter core to form the honeycomb filter tube. This tube is constructed by winding, according to a prescribed pattern, a specially processed coarse cotton yarn of soft texture around an open metal supporting core so as to form a honeycomb of diamond shaped filtering passages built up by the evenly spaced overlapping yarn. At each layer of yarn a fine fringe of cotton fibers is drawn from the yarn across the diamond shaped passages and locked into position by the subsequent layer of yarn thereby forming many interlaced filtering sheets of uniform density, which remove both coarse and finely divided impurities. The density of the interlaced fibrous filtering sheets can be accurately controlled and varied to meet the differing requirements of filtration.

The party left Commercial Filters Corporation at noon and boarded a bus bound for Providence and the second portion of the day's program. En route lunch was served.

The first part of the afternoon program was devoted to a trip through one of Fram's main production plants, where filters, on a constantly moving production line were being assembled, packed and boxed for shipment. The next stop was at the East Providence Research Laboratories of the Corporation where the group was welcomed by Steven B. Wilson, president of the Fram Corporation. Then followed an interesting discussion on filtering problems by R. J. Coveney, Fram's chief research engineer, which was, in part, as follows:

"The task of the filter manufacturer is to minimize or entirely prevent entrance of external contaminants in the entering air and fuel stream and to remove from the lubricating oil contaminants that are formed during engine operation. It is obvious that a basic research program involves first a study of the nature of such contaminants, and secondly, a study of the means of filtering them from air, fuel and lubricating oil. Filtration of air and fuels may be accomplished much more easily than filtration of lubricating oils. Lubricating oil filtration is an extremely complex problem. Let us first consider what components may exist in used diesel lube oils. There appear to be five groupings.

(1) The lube oil insoluble contaminants
(2) The lube oil soluble contaminants
(3) The water phase
(4) The diluent phase
(5) The unchanged lube oil

"Our department is attacking the filtration of lubricating oil by a study of the foregoing problems and by a study of means of filtering these contaminants. The organization is composed of engineers, chemical engineers, and chemists. The development of suitable media is carried on by basic fiber study, study of colloids, of attractive and repellant forces, and by detailed study and development of many types of filtering media."

Coveney's talk was followed by a trip through the Fram laboratories at which time the various research methods were explained to the guest professors. After returning to the meeting room the group was addressed by H. E. Robinson, Fram's general sales manager on the historical highlights of the company. Other speakers who were heard during the visit were Dr. W. S. James, vice-president in charge of engineering who is mainly responsible for Fram's high production record on a mass production basis. J. W. Robinson, Fram's chemical engineer demonstrated a device for the separation of immiscible fluids, a development which is aimed at the separation of water from gasoline.

It was an instructive day. Commercial Filters and Fram were gracious and excellent hosts. It is the type of program which should be repeated.

Core making machine at Commercial Filters Corp.

Steven B. Wilson, Fram Corporation president addresses educator group.

Display of Fram products—earliest and latest.

Correction

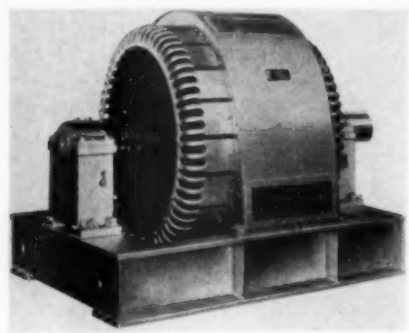
CONTRARY to the statement in February DIESEL PROGRESS story "It Was A Great Motor Boat Show," the Detroit Diesel Engine Division exhibit was not in charge of Griffin Equipment Corporation. The exhibit was, as usual, directed by factory personnel under V. C. Genn, General Sales Manager and W. C. Gould, Marine Sales Manager. It was liberally manned by representatives of Detroit Diesel's Marine Distributor, Diesel Marine & Equipment Corporation of Hoboken, N. J. Mr. A. J. Turk, head of this organization, and his staff were in attendance at the show almost continuously. Griffin Equipment Corporation is the Industrial Distributor for Detroit Diesel in the New York area and as such, had no participation in the Motor Boat Show.

New Diesel Lube Oil

A NEW diesel engine lubricant, designed to counteract the harmful effect of high sulfur fuels, has been developed by a manufacturer who specializes in heavy-duty lubrication problems—the D-A Lubricant Company, Inc. The new product, D-A "Extra-Treated" Diesel oil, is an additive-type lubricant designed for use in high-speed diesel engines. Its development is based on results obtained from full scale laboratory engine tests and field performance records. Owners of certain type diesel engines operating on diesel fuels with a sulfur content in excess of 0.5 per cent have been confronted with the problem of engine sludge resulting in stuck rings plus a high rate of liner wear. The use of D-A "Extra-Treated" Diesel Oil helps to eliminate these sludging and wear conditions. D-A engineers point out that new D-A "Extra-Treated" Diesel Oil is recommended only for use with high sulfur content diesel fuels. Regular D-A Diesel Oil is recommended for use under all ordinary conditions. As oil wells go deeper and more foreign crude oil is imported, a greater percentage of diesel fuels will be marketed with a sulfur content above 0.5%. At present, high sulfur content fuels are being distributed in various parts of the country. D-A "Extra-Treated" Diesel Oil is available direct from D-A representatives or from equipment dealers all over the country.

New Booklet on Generator

THE Ridgway, Pa., Division of Elliott Company has just released a bulletin, code number PB 2400-1, on high speed, Fabri-Steel, synchronous generators.



Elliott Fabri-Steel synchronous generator.

The bulletin is packed with illustrations and descriptive copy and states three features of the generator, which are: Ruggedness—All-welded steel stator frame for enduring strength, rigidity, and pleasing appearance. Laminated steel rotor spider with dovetail poles. Dependable—Mica wrapper or tape on slot portion of stator coils for long life. Well insulated and securely fastened field coils for trouble-free operation. Easy to maintain —Accessible for periodic cleaning and has removable bearing sleeves for quick inspection or replacement. The bulletin is offered to you upon request.

Willcox Named by Elliott Company

JAMES D. WILLCOX, JR., has just been appointed district manager of Elliott Company's Houston, Texas, territory according to an announcement by F. W. Dohring, vice president in charge of sales, Jeannette, Pa. Willcox came with Elliott in 1935 after graduation from Cornell University as an electrical engineer. From 1937 until his recent appointment, he was with the Atlantic district office, except for three years of service in the Navy during World War II.

(Left to right) Dr. Frederick A. Price, Consul-General of Liberia, Nancy Ann Christie and her father, Lansdell K. Christie, President of the Monrovia Port Management Company, after the christening by Miss Christie.

TUG FOR LIBERIA

By WILL H. FULLERTON

The "Pormanco" first diesel vessel constructed for the port of Monrovia, Liberia, on trial runs.

The 50 foot twin diesel tug "Pormanco" being loaded on the deck of the "African Patriot."

A FIFTY FOOT twin diesel tug, the first vessel ever constructed for the U. S. built port of Monrovia, Liberia, was recently launched from the ways of the Mill Basin Ship Repair Company, in Brooklyn. Powered by two General Motors, 225 hp. Detroit diesels, supplied by Benjamin's for Motors, the tug has a cruising radius in excess of 1,000 miles.

After being christened *Pormanco*, in the Brooklyn yard, the tug was delivered to the Farrell Lines pier in Brooklyn, where a Merritt Chapman & Scott crane barge, loaded her on the deck of the *African Patriot*, a Farrell Lines freighter, for delivery to Monrovia.

Upon the tug's arrival, in this new modern U. S. built port, the *Pormanco* will play an active part in carrying out port operations. Completely steel welded throughout, the tug is 50 ft. long, has a 16 ft. beam and a 6 ft. draft. The two Benjamin's installed diesels turn 52 in. Columbian Bronze wheels through 4.5:1 Snow-Nabstedt reduction gears. Running free the *Pormanco* has a speed of 10.6 knots with engines turning at 1750 rpm. The engine controls include Columbian Bronze hydraulic throttle controls, Stewart-Warner panel board, also forward and reverse controls for each diesel. All the controls are located in the pilot house and so arranged as to enable one man to efficiently pilot the vessel. Forward of the pilot house are comfortable crew's quarters for four. The *Pormanco's* shell below the waterline is 5/16 in. plate and above the waterline ¼ in. plate. The deck is ¼ in. checkered plate and the pilot house ¼ in. Due to the fact that the *Pormanco* is the first vessel constructed for Monrovia, her christening received widespread attention. Present at the ceremonies was Dr. Frederick A. Price, Consul-General of Liberia, Lansdell K. Christie, President of the State Department appointed Board of Directors of the port of Monrovia and many members of the Board of Directors including: Capt. George Wauchope of the Farrell Lines, J. S. Vesey-Brown, Socony Vacuum Oil Co., L. E. Barry, Mississippi Shipping Co., and George Butcher, Texas Co.

Nancy Ann Christie, daughter of the President of the Monrovia Port Management Company smashed the bottle of champagne against the hull of the 50 ft. tug, thus sliding the *Pormanco* down the ways to its first official taste of salt water.

Construction of the port of Monrovia where the *Pormanco* will operate was begun by the Navy during the war and was completed in 1948. Prior to the opening of the port, no facilities were available for handling ships cargo. Lansdell K. Christie explained the changes the part has brought about when he reported that now for the first time it is possible to develop rich Liberian iron ore resources on an extensive scale. Mill Basin Ship marks up another first with the *Pormanco* which is slated to play an important job in bringing iron ore to a steel-hungry world.

INTAKE AIR FILTRATION

An Appraisal of Dry and Viscous Air Filter Media

PROPER air intake filtration can not be overstressed in any discussion of diesel engine maintenance. It has become a vital factor for successful operation in many individual cases and in many fields, especially in the tractor field, proper air filtration has meant the difference between success and failure for more than one company.

The recent emphasis on micronic filtration has also added impetus to this development. There can be no doubt that micronic dust particles can make short work of liners and rings of an unprotected engine. Dirt and grit in the intake air of a diesel is more damaging to the engine than contaminants in the lubricating oil.

To find out some of the recent developments in air filtration we called on the Dollinger Corporation in Rochester. Here we could see what one manufacturer was doing.

The Dollinger Corporation was founded in 1921 by L. L. Dollinger under the name of the Staynew Filter Corporation. Dollinger had previously had experience with air filtration problems in his former position with the Cleveland Tractor Company. He was convinced that the air filter was an engine accessory that would become a vital part of most internal combustion engines. His first venture into the rapidly growing automobile industry was successful and soon Protectomotor filters appeared on a variety of cars. In 1925 the company designed and built the model "D" filter. This marked Dollinger's entry into a much wider field. Now it was possible for the company to provide air filtration for large engines and compressors. This was the development which led the company into the diesel engine field.

The Dollinger Corporation pioneered the radial fin type of filter construction from the start and have constantly improved the efficiency of this high volume type element. Now up to 8,000 cu. ft. of air per min. can be handled by a single unit. This of course is dry type filtration, with air passing through the fabric and leaving behind dirt and other foreign particles. This is compared with viscous filtration which consists of a coarser media such as wire mesh which is oil impregnated. The dirt, in this type of filter, impinges on the screening and is held by the oil on the wire mesh. Both types have advantages. The argument for the dry type being that it assures positive protection. In other words the media does not depend upon oil to catch the dirt. A second advantage is that less maintenance is required. As dust accumulates on the filter surface it becomes more efficient in removing dirt from the air. However this will slowly build resistance and it is then necessary to change or clean the elements. Repeated tests in dirty locations show a resistance of only 3.71" H_2O after one year's operation. Generally this type will only require attention every two years. Under the most adverse dust conditions it will need cleaning only twice each year. Dry filtering media does not require high velocity flow as is required by some types of viscous filters. This permits the utilization of oversize filters and the resultant lessening of maintenance costs. Air temperature has no effect upon the operation of the unit.

When new, the dry type filter has a resistance to air flow of less than ½ in. of water. Its construction is rugged. The filter media is backed up by heavy rust resisting wire mesh supporting fins, which are in turn supported by a rigid expanded metal central tube. These are all enclosed within a heavy gauge steel weather proof housing. A silencer type filter is also built which incorporates a series of baffle tubes around the inside of the housing. These tubes have the effect of muffling intake pulsations.

In 1936 the company became interested in high volume air filtration such as could be utilized for air conditioning installations for large plants. They developed the Staynew Automatic Filter as an answer. Lately these filters have been adopted for diesel engine air filtration and many new diesel installations have been specified with this type of unit. The automatic cleaning features of this filter do away with the maintenance problems encountered in other types.

The automatic filter is of the viscous type and consists of a vertical box frame which houses two rotating endless curtains. These curtains are carried on roller chains which are in turn driven by sprockets keyed to the shafts of the curtain rollers. These rollers float on ball bearings. The curtains themselves are made up of a number of removable panels each comprising a single layer of bronze screen cloth to which are attached layers of woven copper mesh. The bronze screen is always on the air entering side of the curtain and acts as a lint trap while the inner woven mesh provides a large impingement area for the retention of dust particles. The first curtain is the denser of the two and acts as the filtering element. It travels through the oil bath for periodic cleaning. The second curtain does not enter the oil bath but acts as a safeguard against oil entrainment in the filtered air stream. The curtain is rotated by an electric motor driven through a reduction gear. A time switch is installed to control the rate of curtain movement. A precaution is taken against too much oil being carried by the curtain into the air stream by the use of a patented air brush conditioner which directs jets of compressed air through the curtain panels just before they enter the main air stream. For various applications requiring varying degrees of filtration and air flow two different filter curtain designs have been perfected. One Type, HD, is designed for handling large quantities of dust with high efficiency. The other type probably more suitable for diesel plant air filtration is the Type HE which provides high dust arrestance efficiency. Both types maintain low resistance to air flow.

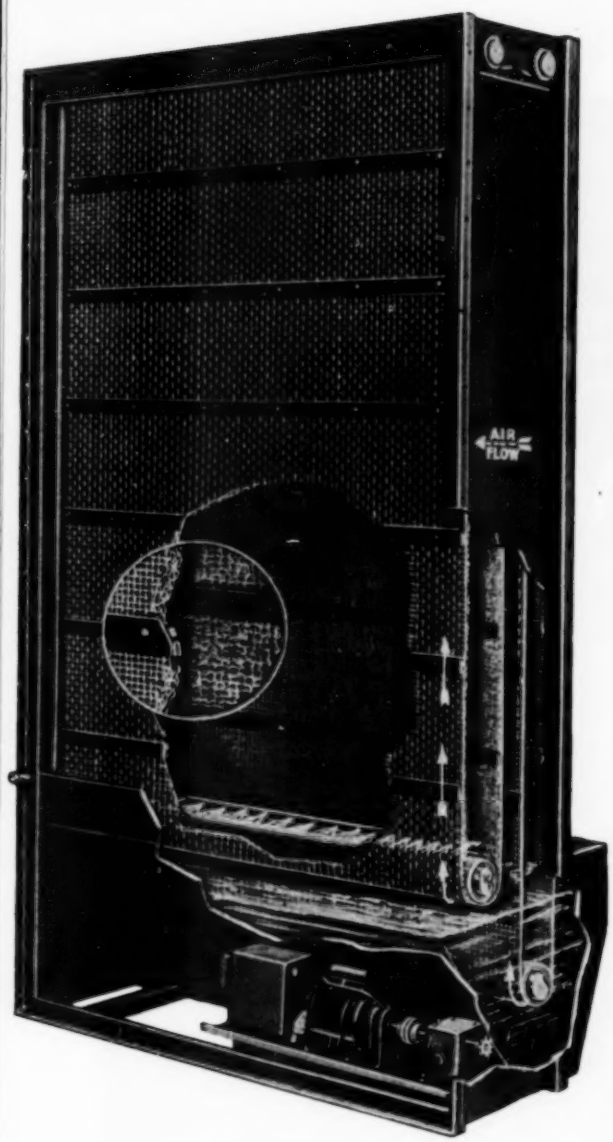
There is really little competition between the dry and automatic viscous type filters as offered by the Dollinger Corporation. The field of application for both types are more or less clearly marked. Primarily it is the size of the diesel installation which determines which type is better suited to do the job. When large volumes of air are required the viscous type is the better suited. On single engine installations the dry type is more adaptable.

Dollinger Corp. also manufactures a complete line of liquid filters which should be mentioned in any discussion of the products of the company. These liquid filters are of the same general radial fin design as the air filter but are of heavier construction. Their capacities range from 1 to 800 gpm. All models have the "swing-bolt" head construction permitting easy access for inspection, cleaning or maintenance.

These liquid filters can be supplied with a wide range of filtering media suitable for all types of fluids. The wool and wool felt elements are most suitable for diesel engine use. The elements are replaceable. Micronic elements are available which remove particles down to 2 microns or less.

The company also manufactures a line of crankcase breather filters which are designed to prevent the entrance of dirt and the escape of oil in vapor or droplet form.

The Dollinger line of Staynew Pipeline filters are built for use with high pressure air or gas in industrial service. Recently the company has begun development on filters for gas transmission lines for one of the major oil companies.



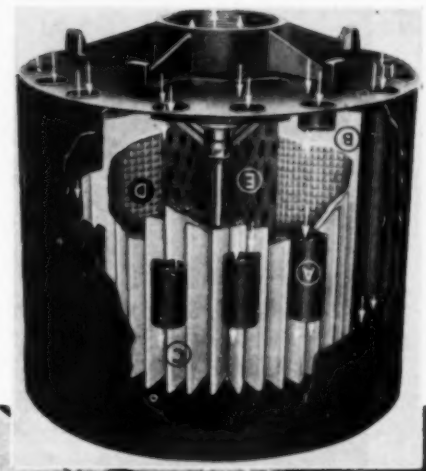
(Above) View of Dollinger Corporation plant in Rochester, N. Y.

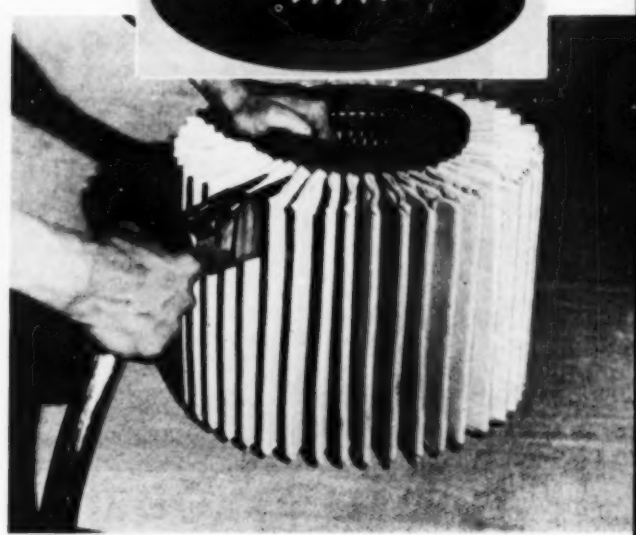
(Left) Automatically operated Dollinger, viscous-type air filter.

(Right Cutaway view of Silencer type air filter for diesel or compressor service.

(Below left) Six panel type automatic air filters.

(Below right) Cleaning radial fin type air filter element with vacuum cleaner attachment.

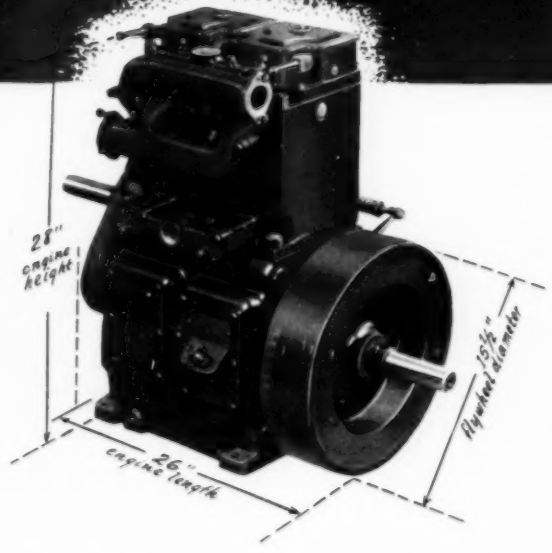




Announcing

The Crofton

10-hp INDUSTRIAL DIESEL ENGINE



Specifications
2 Cylinders, 4 Cycle, 67.6 cubic inches
Bore 3.15" Stroke 4.33"...
10-HP. AT 1500 RPM. Thermo-syphon cooled, weight 450 pounds.

The first truly "Industrial" small Diesel offered the American Market . . .

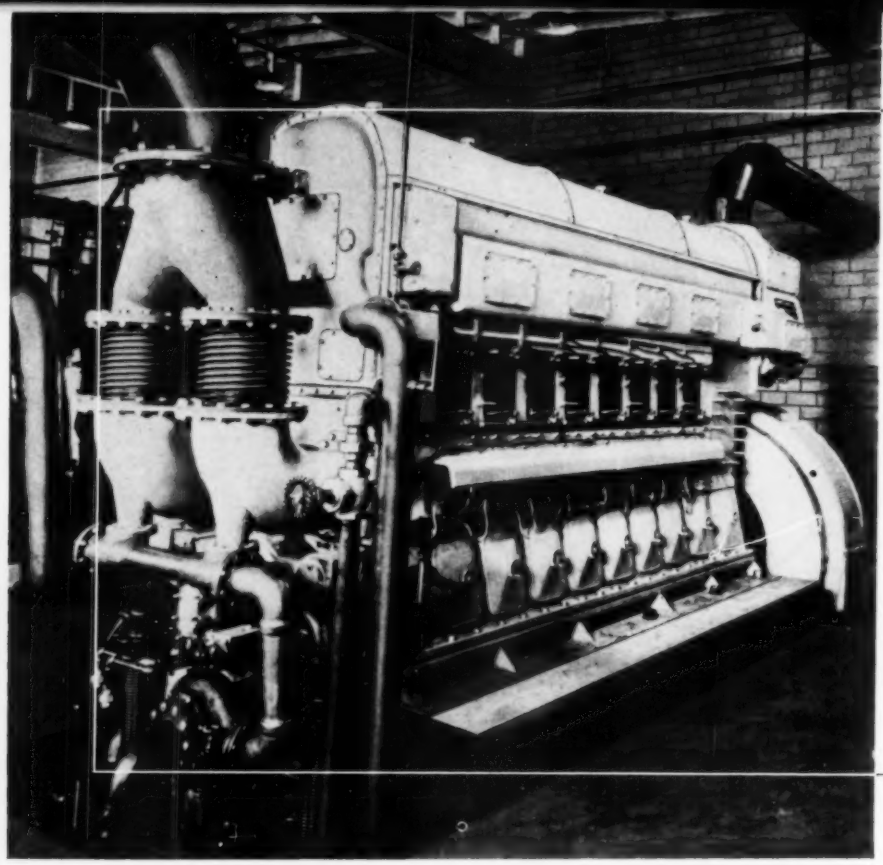
- *Offered with "Engine Speed" power take off shaft on flywheel, users option of "Half Engine Speed" or full engine speed take off on the end opposite the flywheel.*
- *Offered as true "Hand Start" or Electrical start at users option.*
- *Offered with "Fluid Drive" Vee belt pulley.*
- *Guaranteed . . . and marketed by one of Americas oldest small Diesel Engine Companies.*

The Crofton Industrial Diesel has a wide range of application. Write for details.

Crofton

DIESEL ENGINE COMPANY

SAN DIEGO, CALIFORNIA



The 1280 hp. opposed piston Fairbanks-Morse diesel generating set. An additional 1600 hp. F-M opposed piston diesel was recently added to the Lake Mills plant.

LAKE MILLS, WISCONSIN

By L. W. ALLEN

LAKE MILLS, a big little city centered in one of the most prosperous and beautiful sections of the famed Southern Wisconsin Dairyland celebrated its one hundredth birthday anniversary not long ago. An important part of its history is integrated with that of its business managed, efficient, municipally owned electric utility. The domestic use of electricity in Lake Mills dates from 1892 when a franchise was granted to a local manufacturing plant to generate and distribute electric energy. Flat rate charges for this service were based on the use of "live" and "dead" lights, $1.50 per month for the former, and $.75 per month for the latter, with a minimum monthly charge of $3.50. "Live" lights were those in kitchens, dining- and living-rooms. "Dead" lights were those in bedrooms and basements, and were to be used only in emergencies. Service was available from dusk until midnight. The year 1911 climaxed the growing pains of the adolescent utility, and after a referendum vote with only a handfull of dissenters, the City purchased the electric plant and placed it under the management of a three man non-political utility commission. By this time also the original 150 hp. steam driven generator was outgrown and additional energy was being purchased from a private utility serving the area. A long range program of expansion and increasing sales brought the utility to its second major milepost in 1930 when the purchase of energy was discontinued with the completion of a new F-M diesel generating plant. The initial installation included two 420 hp. and one 210 hp. units. Consistent growth required the addition of a fourth diesel of 600 hp. in 1936 in space initially provided in the new plant. Paralleling the increasing use of energy and the reduction in costs with diesel generated versus purchased power were rate reductions of 10% in 1932, 12% in 1933, 8% in 1934, and 11% in 1935 which resulted in the following residential rate schedule—one of the lowest in the state.

Service Charge—50c per month plus
2.6c per kwh. for the first 50 kwh per month
2.0c per kwh. for the next 150 kwh. per month
1.5c per kwh. for over 200 kwh. per month

Commercial and industrial power rates were correspondingly low, and energy for off-peak water heating was available for 1c per kwh. In spite of these low rates the utility had paid for all improvements and expansion from net earnings, at the same time paying its full share of taxes (the utility is the second largest taxpayer in the city) and making substantial cash contributions to the general city fund each year.

War year demands taxed its generating and distribution facilities severely but without impairment to service. Additional generating and distribution equipment was unobtainable until 1946, which marked the third major milepost in the history of the utility. In this year an F-M 1280 hp. opposed-piston diesel generating set was installed on the slightly altered foundation of the original 210 hp. unit, no longer useful because of its size. The second step of this latest expansion program was concluded early in 1948 with the installation of a second F-M opposed-piston engine, this one of 1600 hp., on the foundation originally occupied by the 600 hp. engine. Thus without any increase in plant floor space this generating station has increased its capacity from the original 1050 hp. to the present 3720 hp. Future additional generating capacity without housing expansion can be similarly effected by the replacement of the original 420 hp. units.

A thumbnail summary of the accomplishments of this utility from 1911 to 1948 reads—generating capacity increased from 150 to 3720 kw., annual generation from 200,000 to 6,000,000 kwh., total customers from 243 to 1625, and system evaluation from $40,000 to $550,000. In this city of 2,300 people, 700 homes cook with electricity, and 340 homes heat water electrically, with more electric ranges and water heaters being added weekly.

Small wonder, then, that the policy adopted by the Utility Commission in 1911 "good service at the minimum cost consistent with sound management" has contributed so substantially to the health, comfort and prosperity of the Utility's owners and stockholders, all the people of Lake Mills, one of Wisconsin's biggest little cities.

Michel Kadenacy

Michel Kadenacy, widely known in the Diesel Industry, both here and abroad, for his work in developing a system which utilizes the energy exhaust to evacuate the cylinders and to provide self induction, died February 17.

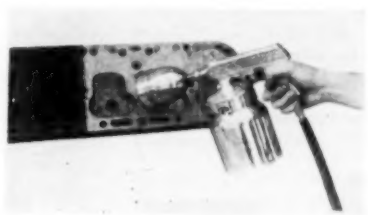
Kadenacy was born in Russia in 1886 and became a French citizen in his early youth. He had made his home in the United States since 1940 and has passed examination for his second papers for naturalization the day before his death.

First public notices of the Kadenacy system of scavenging and induction appeared in Paris in 1928. After successfully defending many actions against his patent application, Kadenacy was granted a European patent with world-wide coverage. He held 22 United States patents with 10 pending. Some 20 licenses have been granted, both here and in Europe.

It has been claimed that every engine on which the Kadenacy system was tried has been improved. A Junkers engine has been run up to 145 bmep using the system and it has been applied to a wide variety of engine types including valve-in-head, opposed piston, sleeve valve and loop scavenging engines.

Enpro Combination Blast Gun

ENPRO Combination Blast Gun, manufactured by Engineered Products Inc., is a versatile adaptation of sand blasting and solvent spraying. The Enpro Gun improves and simplifies surfacing in automotive and industrial fields. It is air operated and portable, has no wheels to dress and no motors to burn out.



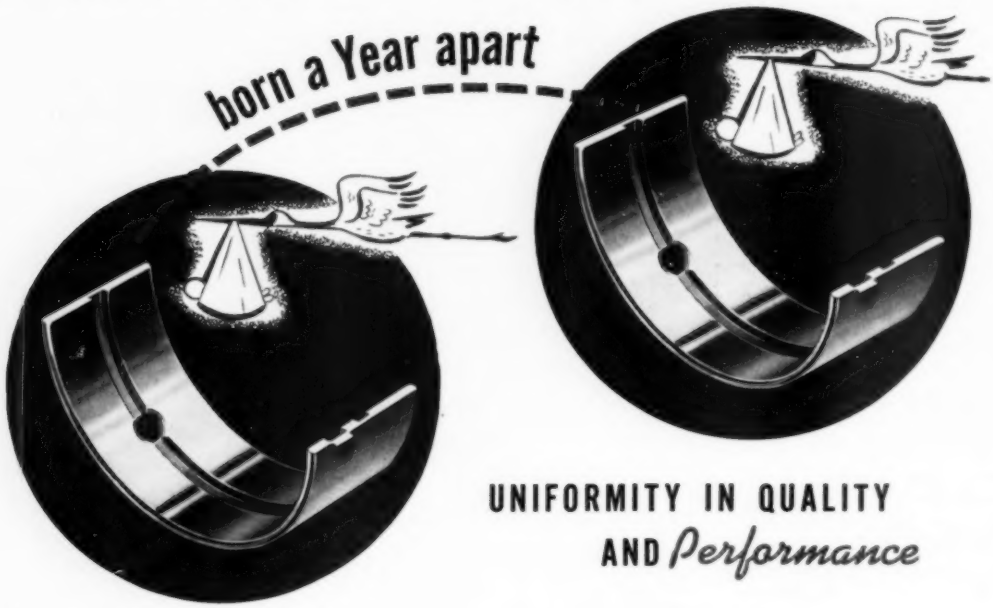
Enpro combination Blast Gun

Enpro is useful in reaching inaccessible places such as wheels, close fittings, odd shapes, drip mouldings, crevices, and grill work. The Gun can be connected to any air line and is equipped for sand blast operations or spraying solvents and liquids. The nozzle is easily changed by loosening a retaining nut and slipping another nozzle in place.

Two attachments are supplied with the Enpro Gun; an "Abrading" case-hardened nozzle for use in "blast" operations and a solvent nozzle for use with oils or chemicals. The abrading nozzle incorporates a safety tip that shows wear when barrel needs replacement. All parts are precision machined and factory tested. Maximum air consumption is 9½ cu. ft. per minute at 100 to 150 lbs. pressure.

IDENTICAL TWINS

IDENTICAL TWINS



UNIFORMITY IN QUALITY AND *Performance*

Little wonder that the two sintered copper-lead main bearings shown above are even *more* alike than two peas in a pod!

Each went through a total of 20 precise manufacturing operations from the sintered strip to the final overplating. In processing they received a total of 35 setup and inspection measurement checks. Eighteen additional checks included analysis, temperature controls, special and visual inspections.

These "twins" aren't special favorites in the Federal-Mogul bearing family, either. We pamper 'em all! With our specialized six-plant organization we can produce large or small runs to your specifications. Engineering consultation available, without obligation.

HIGH SPEED, high temperature, automotive type bearings available in many combinations.

SPEED & LOAD bearings for pumps, compressors, industrial electric motors and similar uses.

HEAVY LOAD for big Diesels, power plants, etc.—bearings up to 27½" O.D., steel and bronze back.

BRONZE PARTS in many shapes, sizes; thrust washers, bushings; for many types of applications.

1899 • 50 YEARS' CONTINUOUS BEARING EXPERIENCE • 1949

FEDERAL-MOGUL

FEDERAL-MOGUL CORPORATION — FEDERAL Mogul Silent SLEEVE BEARINGS — 11039 SHOEMAKER, DETROIT 13, MICH.

Power plus Economy!

Wherever Diesels run, Koppers American Hammered Piston Rings are the first choice. The reasons are crystal clear, as both builders and operators will tell you!

No loss in power—utter dependability—fewer overhauls—and lower fuel and oil consumption!

A miracle in metallurgy is behind these records; the combination of Porous Chrome* and K-Spun Metal has made Koppers American Hammered Rings *the* stand-out on all counts.

If you have a design or maintenance problem, you are invited to consult with our engineering department. Their ability in giving more progress to Diesel power is at your service. Koppers Company, Inc., Piston Ring Department, Box 626, Baltimore 3, Maryland. *Van Der Horst Process

What Porous Chrome Plating and K-Spun Metal mean to you

1. Guaranteed against ring breakage. Tensile strength double ordinary gray iron castings.
2. All rings seat immediately without scuffing and scoring.
3. Ring and cylinder wear greatly reduced.
4. Fifty percent more elasticity retains shape and tension far longer.
5. Four times greater impact strength means long life in severe service.

IN EVERY SIZE, OF EVERY TYPE, FOR EVERY PURPOSE

KOPPERS

American Hammered

KOPPERS PISTON RINGS

Binks Establishes Customer Service Department

J. F. ROCHE, President of Binks Manufacturing Co. announced recently the establishment of a Customer Service Department that goes far beyond the usual handling of customers' inquiries.

Under the new system, incoming calls and correspondence requesting information are channeled directly to Customer Service. The staff of this department collects all required information and answers requests promptly. Delivery promises, quotations, etc., are being checked daily to keep customers informed as to the progress of the work.

Bowser, Inc., Announces Promotions

GERALD J. KLOPFENSTEIN has been appointed to the newly created post of assistant to the vice president and director of sales, Fred S. Ehrman, and James E. Doelling has assumed Klopfenstein's former position as manager of the meter sales division. Mr. Klopfenstein has been associated with Bowser, Inc. for the past 25 years, starting in October, 1923 in the company's inspection department. Mr. Doelling joined the organization in 1937 as draftsman in the production engineering department. Prior to his new assignment he was manager of the sales engineering division.

Fairbanks-Morse Announce Number of Changes in Sales Division

A SERIES of promotions and changes in the Sales Division of Fairbanks, Morse & Co., Chicago, were recently announced by Robert H. Morse, Jr., Vice President in charge of all operations of the company.

O. O. Lewis H. L. Hilleary

D. T. Johnstone L. A. Weom

O. O. Lewis, until a short time ago Assistant Sales Manager, has been promoted to Sales Manager.

Harry L. Hilleary, who for the past seventeen years has been Manager of the firm's St. Louis, Missouri, Branch, is being transferred to the company's headquarters office in Chicago. He has been promoted to the position of Assistant Sales Manager.

L. A. Weom, Manager of the Pump Division, has been transferred to St. Louis to become Branch House Manager, succeeding Mr. Hilleary.

Donald T. Johnstone, Assistant Manager of the Pump Division, succeeds Mr. Weom as Manager of the corporation's Pump Division in Chicago.

New Diamond Chain Distributor for Boston

CHASE, PARKER & CO., INC., 288-290 Congress Street, Boston, have been appointed distributors for the Boston area by Diamond Chain Company, Inc. of Indianapolis, makers of Roller Chains, Sprockets, Flexible Couplings, and Conveyor Chains.

New Combination Air Intake Cleaner-Snubber

DEVELOPMENT of a new line of Combination Air Intake Cleaner-Snubbers has been announced by Burgess-Manning Company. They are used on all 2- and 4-cycle stationary engines (diesel, gas, or dual fuel). They are also used for the intake of all centrifugal and positive displacement compressors and blowers requiring a compact combination intake air cleaner and Snubber. Designated as Series SDF, these units are available in pipe sizes from 8 to 30 in., inclusive. The Cleaner-Snubber is a combination unit which combines intake air cleaning and noise prevention. This Snubber replaces an intake Snubber plus a supplementary intake air filter thus providing an economical method of providing clean and quiet intake air. The Cleaner-Snubber is provided with two alternate connections to the engine intake. One is on the side of the Snubber, for use with an intake pipe extending through the side of the building. The other is a base opening which permits the use of a down pipe from the engine with a horizontal run under the floor to the intake Snubber. This Cleaner-Snubber consists of two Snubbing Chambers to smooth the air flow and one cleaning chamber. The cleaner elements are serviced through one or more large access doors held firmly in place by spring clamps.

Dr. Martinuzzi Joins Cornell Faculty

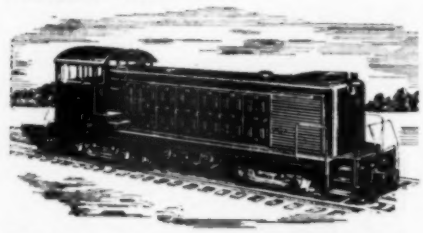
DR. Pio Franco Martinuzzi, noted continental engineering designer, has been appointed a professor of mechanical engineering at Cornell University, President Edmund E. Day announced recently. Dr. Martinuzzi, who is now traveling in Europe, will join the staff in February. A native of Germany and a citizen of Italy, Dr. Martinuzzi is internationally known in the field of automotive and aircraft engine design.

A Symposium Covering Torsional Vibrations and Paralleling AC Installations to be Held at M.I.T., June 13, 14, 15, 1949

A Symposium has been arranged for the men who do the calculating in these two fields for the builders of Diesel engines. Heading up the conference will be Professor Frank M. Lewis and Prof. J. P. Den Hartog, and other members of the M.I.T. staff.

Those wishing to attend should register as early as possible by advising the Diesel Engine Manufacturers Association, One N. LaSalle St., Chicago 2, Ill., of their intention. Arrangements have been made for those attending the Symposium to stay at the Kenmore Hotel. Those wishing such hotel reservations should write to Mr. C. H. James, Hotel Kenmore, 490 Commonwealth Ave., Boston. He has promised to take care of everyone who writes to him for accommodations.

Lima-Hamilton Enters Diesel Switcher Field



THE Lima-Hamilton Corporation, New York, has announced its first sales of the new 1,000 hp. diesel electric locomotives, totaling 16 units, designed for heavy-duty switching service. Ten of the diesel switchers were purchased. Four by the Nickel Plate Road and six by the Erie and New York Central Railroads.

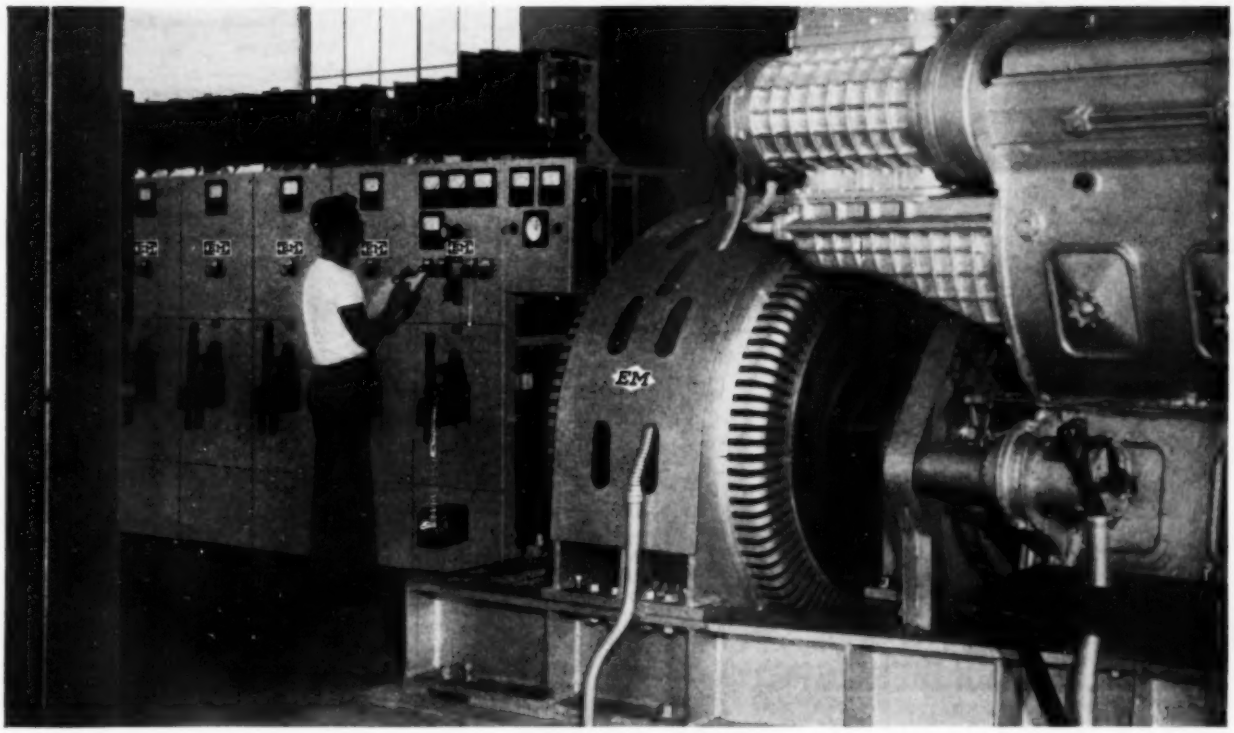
John E. Dixon, president of Lima-Hamilton, said that the new locomotives mark the entrance of Lima-Hamilton into the diesel switcher locomotive field. The locomotives will be manufactured at the company's Lima, Ohio, division.

The locomotives are powered by the new Hamilton 9 by 12 diesel engine, manufactured at the Hamilton, Ohio, division. The Hamilton 9 by 12 diesels are of vertical, eight-cylinder, four-cycle supercharged design, and incorporate an intercooling system on these superchargers.

The diesel switching locomotive, suitable for a variety of services, is capable of producing the full 1,000 brake horsepower for traction. Singly it can traverse a minimum curvature radius of 75 feet, or a radius of 100 feet when hauling trains. Of locomotive class BB, the switcher, weighing 120 tons in working order, has a maximum speed of 60 mph. Starting tractive force, 25 per cent adhesion, is 6,000 pounds, and the tractive force, continuous at 8.9 mph, is 34,000 pounds. Over all wheel base is 32 feet 6 in.; diameter is 40 inches, and length inside coupler knuckles, 47 feet 10 inches. Capacity for fuel oil is 600 gallons, while that for cooling water is 190 gallons, and for lubricating oil, 170 gallons.

Diesel Shovel On Railroad Job

C. J. Langenfelder and Son, Inc., Baltimore, Md., used this Lima shovel, powered with a Cummins Diesel, on a construction job for the Pennsylvania Railroad between Baltimore and Sparrows Point. The shovel has a 1½-yard bucket and a 22-foot boom, and loads an average of 360 seven-yard trucks in 10 hours. Working in sand and clay, in one regular work day this Cummins-Powered Lima shovel loaded 2,897 cubic yards of material. The excavator is one of 23 units now being used by Langenfelder that are powered with Cummins Diesels.



Matched Switchgear and Generators

SET NEW STANDARDS OF EFFICIENCY FOR MODERN POWER PLANTS

HERE is an example of matched E-M Switchgear and a 2400/4160 volt E-M Generator with a diesel engine in an upper Midwest Power Plant. The coordinated units give more satisfactory performance and smoother generation of electric power. There is greater dependability and economy.

In matched installations, factors to be considered are generator loading, power factor, motor starting, metering, voltage regulation, synchronizing and protection. These factors help efficiency and performance in your plant.

Consideration of these factors has lead to one pace-setting E-M development after another—Pre-engineered Switchgear with the advantages of custom-built gear and the economy of stock units—Generators that from their welded, rolled steel frames to their multi-layer coil insulation show the steady advance made by this company through a half century of building for year in and year out dependability.

This tremendous experience in meeting generator and switchgear requirements is available to you. E-M has field engineering and sales offices in 53 principal cities where competent advice is yours for the asking.

Talk to your nearest E-M field engineer or write to us for more details on matched generators and switchgear for your power plant.

ELECTRIC MACHINERY MFG. CO.
MINNEAPOLIS, MINNESOTA

2200-TPA 2090

SPECIALISTS IN GENERATOR AND SWITCHGEAR ENGINEERING

D.E.M.A. Sponsors Buffalo Conference

Worthington, Houde Engineering, Ross Heater and Manzel Co-Sponsor Interesting Meeting For Engineers and Educators

A WELL-PLANNED, splendidly executed program rewarded the large group of engineers and educators who attended the DEMA Conference at the Buffalo, New York plant of Worthington Pump and Machinery Corporation, the middle of January. George Steven, Executive Engineer with Worthington, acting as M. C. kept the well filled agenda moving on schedule. Those contributing the papers were well rewarded for their efforts by enthusiastic expressions of gratitude and lively discussion. Following a warm welcome by A. C. Ross, Worthington Works Manager, the following program filled the day:

Cooling of Internal Combustion Engines
W. J. Blessing, Chief Engineer, Diesel Division, Worthington Pump & Machinery Corp.

Diesel Engine Lubrication
H. Hall, Asst. Chief Engineer, Diesel Div., Worthington

Torsional Vibrations In Engine Installations
C. M. Lowell, Asst. Engineer, Diesel Div., Worthington

Diesel Engine Cooling
T. Tinker, Chief Engineer, Ross Heater & Mfg. Co.

Force Feed Lubrication & Engine Application
H. Bellinger, Engineer in Charge Lubrication Division, Manzel, Inc.

What Industry Expects of College Graduates
E. Dahlund, Educational Director D.E.M.A.

Viscous Torsional Vibration Dampener
B. E. O'Connor, Asst. Chief Engineer, Houde Engineering Co.

Discussion of Summer Employment.
Harvey T. Hill, Executive Director D.E.M.A.

Interspersing the papers, were question and answer periods and two inspection tours through the Worthington plant giving the group an opportunity to view the extensive line of Worthington diesel and gas engines and compressors in all stages of production. An excellent lunch and a superb dinner completed a most profitable and pleasant day.

Fram Announces Promotions

FRAM Corporation has announced promotion of three men to important key positions, at a recent meeting of its Board of Directors.

Arthur F. Pettet was appointed General Manager of Fram Corporation, East Providence. Since 1947 General Production Manager of all Fram operations located in Pawtucket, Rhode Island; Independence, Kansas; Jacksonville, Florida; Otsego, Michigan and Pittsburg, California, Mr. Pettet first joined Fram Corporation in 1942. From 1942 to 1946, he served as Assistant to the General Manager. Mr. Pettet will have headquarters at the company's general offices in East Providence, Rhode Island.

David C. Buell has been named General Production Manager. With headquarters at the Pawtucket, R. I., branch, Mr. Buell will take over responsibility for production management of Fram's various manufacturing plants.

Bruce C. Miller succeeds Mr. Buell as General Purchasing Agent. Formerly manager of the Otsego plant, he came with Fram Corporation, as assistant to the President, in 1945. Mr. Miller will make his headquarters at the company's general offices in East Providence.

Ohio Crankshaft Bulletin

THE Tocco Division of The Ohio Crankshaft Company, Cleveland, Ohio, recently announced the availability of a comprehensive 48 page illustrated brochure on Induction Heating. The first part of the booklet is devoted to the general principles involved. The four following sections deal with actual case histories of Induction Heating for hardening, forging, brazing and annealing. You can obtain, free of charge, any of these sections or the complete book by writing The Ohio Crankshaft Company, Dept. F-20, Cleveland 1, Ohio.

S.S. ALGERIE
sails with HONAN-CRANE

OIL PURIFICATION on the six 1200 hp Nordbergs aboard the Algerie is handled by Honan-Crane, as specified by the Tampa Shipbuilding Company.

Yes, the Algerie and five sister ships have the compact and dependable oil purification system that is right for marine use —Honan-Crane. Easily serviced in low headroom quarters, 18 inch clearance is needed for the double-deck filter refills.

For full information on low cost purification of diesel fuel and lube oils, write to Honan-Crane Corp., 202 Indianapolis Ave., Lebanon, Ind., a subsidiary of Houdaille-Hershey Corp.

How to Stop DIESEL TROUBLES Before They Start

The compression-ignition principle of Diesel engines makes regular checks of compression of all cylinders vitally important. Maintaining correct compression pays off. It means keeping your Diesels running at peak efficiency. The result is greater operating efficiency, longer engine life, and lower maintenance costs.

The MOTORITE Diesel Compression Tester simplifies checking compression pressure. It is easily attachable to any make of Diesel by means of an interchangeable adapter which takes place of the fuel injector. In addition to a "universal" adapter which serves more than 50 makes and types of Diesels, we have a complete line of special adapters for practically every commonly-used Diesel engine.

For full particulars write for Bulletin 606.

ATTENTION Distributors!
Diesel equipment and accessory jobbers are invited to write for information about attractive distribution proposition.

BACHARACH Industrial Instrument Company
7000 Bennett Street · Pittsburgh 8, Pa.

KIENE MODEL K-120 UNIVERSAL PEAK PRESSURE INDICATOR

Model K-120 with cooler body and nozzle dummy.

For

Testing Firing and Compression Pressures on all Models of Diesel and Gas Engines

Dependable — Easy to Use — Rugged. May Be Used With or Without Flexible Tube

MODEL K-120 Indicator has but one moving part—nothing to wear or get out of adjustment.

VALVE—Gas trap type with diaphragm type check valve having adjustable lift. Stainless steel valve and seat.

No springs—No pistons—No complicated adjustments—No temperature corrections—no pressure loss in check valve.

GAGE READS TRUE PRESSURE—MAY BE RECALIBRATED ON ANY GAGE TESTER

Check readings can be made over and over again by releasing indicated pressures with bleeder valve.

GAGE—Hydraulic 3½ inch dead weight tested in suitable range to specification requirements.

ADAPTORS available for most models of engines manufactured in U.S.A. Other models made to order at reasonable prices.

DESCRIPTIVE BULLETINS AND PRICES FURNISHED ON REQUEST

Manufactured under patents No. 2280411, No. 2325325, others pending

KIENE DIESEL ACCESSORIES, INC.
10352 PACIFIC AVE., FRANKLIN PARK, ILLINOIS

KODIAK of Vancouver, B. C.

Highline halibut boat of 1948. Powered by **UNION** Diesel built in 1927

The **UNION DIESEL ENGINE** *Co.*
2200 EAST SEVENTH STREET
OAKLAND 6, CALIFORNIA, U. S. A.

NOW AVAILABLE

NEWLY REVISED BROUGHT UP TO THE MINUTE

13th edition of the DIESEL ENGINE CATALOG

THE ENTIRE DIESEL INDUSTRY UNDER ONE COVER

Whatever you are looking for in diesel engines, or accessories, you will find them described and illustrated in the 1948 DIESEL ENGINE CATALOG, Volume 13, edited by Rex W. Wadman. What's more, you will find complete specifications on

840 DIFFERENT MODELS

The Products of 53 Engine Manufacturers. Each engine description is complete and accurate—checked and double-checked by the Manufacturer himself. Illustrations include full page engine views, lube and fuel system diagrams, also cooling systems—many traced in color. But that is just the Diesel engine section. The Catalog also includes an accessory section carrying valuable information on the various Fuel Injection Sytems, Gear and Chain Drives, Turbochargers, Blowers, all fully described and profusely illustrated.

FOR DESIGN AND OPERATING ENGINEERS AND BUYERS

There is a Market Place Section—a directory of Diesel engines classified as to ratings and speeds with manufacturers' names and addresses—and a Product Directory including accessories, parts, materials and services—all classified as to products. The Market Place tells you at a glance where to find what you want for your engine or plant.

NO OTHER DIESEL BOOK LIKE IT

Really 4 Books In One

1. **The main section is devoted to descriptions, illustrations and specifications of all the Diesel engines manufactured in this Country.**
2. **A large section carries complete illustrated descriptions of Diesel engine and plant accessories.**
3. **The Market Place—a classified directory of Diesel Engines and Accessories.**
4. **Manufacturers' Advertisements—informative—helpful.**

REVISED ANNUALLY

The most widely-used Diesel reference book published:—Because the book is revised and brought up to the minute each year, thousands of design and operating engineers, purchasing and sales executives, Diesel students buy the DIESEL ENGINE CATALOG each year and constantly refer to it throughout the year. The 1948 Edition, Volume 13, embodies sweeping changes—new models and types, revised designs, and carries the basic information published in previous editions. Whatever your interest in Diesels is you will find this Edition of the DIESEL ENGINE CATALOG indispensable.

DIESEL ENGINE CATALOG
Two West Forty-Fifth Street, New York 19, N. Y.

Enter my order today for a copy of the 1948 Diesel Engine Catalog, Volume Thirteen, Edited by Rex W. Wadman, for which I enclose $10.00, also payable at £2 10s. 0d. to E. H. Doddrell, 342 St. Paul's Corner, Ludgate Hill, London E.C.4.

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COMPANY ..... TITLE .....

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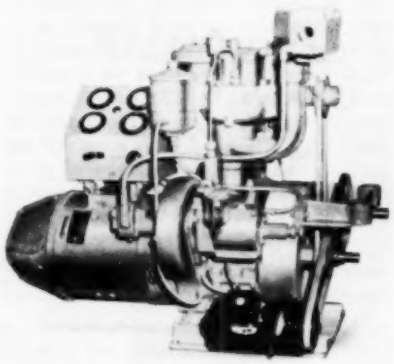
ORDER YOUR COPY TODAY *Your copy will be shipped promptly upon receipt of your order.*

Sheppard Announces New Diesel Engine



The new Model 8, water-cooled Sheppard diesel with 2 kw generator.

THE R. H. Sheppard Company, Inc., announces the addition of a new water-cooled engine to its line of diesel engines. The new engine has been subjected to exhaustive tests and is now ready for distribution through the nation-wide Sheppard dealer organization.

The new engine known as Model 8, is a 4-cycle, 1-cylinder, full Diesel engine rated at 5.4 hp. maximum, and 3.5 hp. continuous. The Model 8 was designed as a water-cooled version of the Sheppard Model 14, single-cylinder, air-cooled Diesel engine. The new engine was developed expressly for use aboard ships in locations where it is impossible to secure sufficient quantities of free circulating air for efficient cooling of the air-cooled engine. It is available to power air compressors, fish wash pumps, fire pumps, bilge pumps, bait pumps, cargo hoists, fish hoists, winches, etc.

Model 8 Specifications

Bore	3″
Stroke	4″
Cylinders	1
Maximum horsepower (@ 2000 R.P.M.)	5.4
Continuous horsepower (@ 1800 R.P.M.)	3.5
Piston displacement (cubic inches)	28
Piston speeds:	
@1200 R.P.M. (F.P.M.)	800
@ 1800 R.P.M. (F.P.M.)	1200
Cooling system	Heat exchanger
Cam shaft	Gear driven
Standard Governor Regulation	3½%
Starting system	Hand or 12 volt electric
Diameter of mains and crank pin	2″
Number of main bearings	2
Exhaust pipe diameter	1″
Crankcase oil capacity	9 pts
Standard fuel tank capacity	2 gal

Full diesel engine—solid fuel injection—compression ignition.

The Sheppard Model 8 is available as a power unit or as a 2 KW generating set. For further information write: Sheppard Diesel Engines, Hanover, Pennsylvania.

New Johnson Catalog

A NEW catalog, covering the complete line of industrial bearings made by the Johnson Bronze Company, is now available to you upon request. This year's catalog has additional illustrative and descriptive data on several new sizes of general purpose bearings, electric motor bearings, and universal bronze bars. Also, introducing a new feature this year are the self-aligning bearings, which are a product of powder metallurgy, or as they are usually referred to "self-lubricating" bearings. All of the various items listed in this catalog are available immediately from stock.

Metric-Size Open End Wrenches

TEN new Proto open end wrenches with metric-size openings have been announced recently by the Plomb Tool Company, Calif. They are intended for mechanics who maintain foreign-made equipment. Opening size combinations, in millimeters, are 6 x 7, 8 x 9, 10 x 11, 12 x 13, 14 x 15, 16 x 17, 18 x 19, 20 x 22, 21 x 23 and 24 x 26. This wide range of sizes makes the wrenches suitable for Italian and French automobiles, as well as gear cutters and other types of industrial equipment made in Europe. The wrenches are forged.

Operating Costs of Diesel vs. Gasoline Trucks and Buses

Diesels Win Hands Down in Both Instances

EACH of two independently-prepared papers presented at the annual meeting of the Society of Automotive Engineers in Detroit, in January, favored the diesel in direct comparison with gasoline engines for truck and bus service.

The analysis of cost accumulation in truck service was presented by Howard L. Willett, Jr., executive vice president of the Willett Co., operator of a fleet of trucks in Chicago. Mr. Willett advanced a new theory of cost accumulation and analysis, termed the "cutaway" method. Using this method, only the cost records of truly comparable trucks are considered—that is, trucks which carry the same load over the same terrain for the same calendar period. Further to avoid distortion of cost records, the trucks under observation must be of the same age and of the same general manufacture. Driver morale even enters the picture.

Putting this theory to work in his own fleet, Mr. Willett developed cost figures on trucks operating 36,000 miles per year over a period of six years showing a total cost of $22,320 for the diesel truck as against $32,940 for the gasoline truck. Adding to these operating costs, the original list prices of $9,500 for the diesel truck and $7,500 for the gasoline truck, the gross costs became, respectively, $31,820 and $40,440, or a net saving of $8,620 in favor of the diesel-engined truck.

The case of diesels versus gasoline engines in buses was presented by E. N. Hatch, senior mechanical engineer for Board of Transportation, New York City Transit System. His paper was built around an 8-point analysis embracing, (1) First cost of the engine; (2) Fuel cost; (3) Maintenance cost; (4) Availability of engines; (5) Availability of fuels; (6) Operating requirements; (7) Public acceptance; (8) Garage and maintenance requirements. Interesting conclusions were drawn on each point—all leading, however, to the final conclusion that the diesel engine in city bus operation is definitely more economical than the gasoline engine.

On point (1), it was shown that the initial cost of a diesel engine was approximately $1,000 more than that of a comparable gasoline engine. This condition is changing quite rapidly, Mr. Hatch observed. Cost of fuel, based on an average throughout the system for a period of 12 months was 11.55c per gallon for gasoline and 11.72c for diesel fuel. Despite the fuel cost differential in favor of gasoline, Mr. Hatch quoted extensive operating records of buses similar in every respect except some were diesel- and some gasoline-propelled, and running over the same route, to show a fuel saving of about $500 per bus per year in favor of diesel.

In the matter of availability of engines it is admitted that gasoline engined buses have been purchased to obtain quick delivery even in the face of preference for diesels—but this condition is changing.

On the other points of comparison between diesel and gasoline buses it becomes nearly a toss-up with a slight edge in favor of gasoline engines in some maintenance operations. For example, the diesel fuel system costs some $50 more per year to service. But Mr. Hatch quickly admits that his company is happy to spend $50 or even $100 to save $500. It all comes back to the basic and relative overall efficiency of the two engines which is admittedly 2 to 1 in favor of diesel and which comes through the operating records of this unusually large and active fleet in the form of $500 per bus per year—saved by the diesel engine.

New Removable Sump Simplifies, Speeds Up Oil Filter Cleaning

A NEW "removable sump" collects sludge and heavy particles for easy removal and is designed to facilitate oil filter cleaning at cartridge-replacement time. This "Sedisump" is made and patented by DeLuxe Products Corporation, especially for certain models of the DeLuxe Oil Filter.

The Sedisump eliminates messy oil filter draining and inefficient filter performance due to a gummed-up sump. With this new arrangement, the entire sump, filled with sludge and heavy particles, may be lifted out, emptied, cleaned and replaced in one simple, time-saving operation. The removable sump also permits easy access to the entire sump area of the DeLuxe Oil Filter for quick, thorough cleaning. The Sedisump is installed in a DeLuxe Filter by these two steps: (1) Drop the removable sump over the center tube; it will fall into place naturally, because it is shaped to fit perfectly into the DeLuxe sump area. (2) Then, insert the cartridge and tighten the screw top, thus sealing the Sedisump into place.

To remove the Sedisump for cleaning and servicing, merely slide it up over the center tube, empty and clean, then replace. To avoid spilling sediment on the motor, a little may be poured back into the sump area before removing the Sedisump. Remaining sediment may be scooped up by pushing the Sedisump back into place.

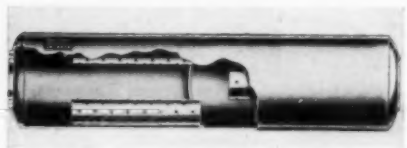
Hercules Promotes John C. Keplinger

MR. John C. Keplinger, Vice President in Charge of Sales of Hercules Motors Corporation, Canton, Ohio, was recently promoted to Executive Vice President of the company. Mr. Keplinger has been associated with the Hercules company since July, 1926 and has served progressively as a member of the sales staff, Sales Manager and Vice President in Charge of Sales. He will continue to direct the sales activities of the company.

Other officers include Gordon M. Mather of Toledo, Ohio, Chairman of the Board; Charles Balough, President and General Manager; M. C. Kuepfer, Vice President in Charge of Production; A. R. Miller, Vice President in Charge of Purchasing and Traffic; D. W. Latta, Vice President in Charge of Special Engineering; Harry P. Blake, Vice President (inactive), and John D. Cook, Secretary-Treasurer.

New Burgess-Manning Air Intake Snubber

BURGESS-MANNING Company has announced a new line of Air Intake Snubbers. They are used on all 2- and 4-stroke cycle stationary and marine engines (diesel, gas, or dual fuel). They are also designed for the intake of all centrifugal and positive displacement compressors and blowers. Designated as Series SD-A, these units are available in pipe sizes from 1 to 30 in. inclusive.



Burgess-Manning Air Intake Snubber.

Burgess-Manning Intake Snubbers operate on the same principle as the Exhaust Snubbers; that is, the cause of noise is removed before the noise can occur. Incoming pulses of air are snubbed so that the oscillating flow of air, which causes "pumping" noise, is smoothed to a unidirectional flow. There is no appreciable restriction of the intake pipe. Vibration and chugging are eliminated. No tuning of the air intake system is necessary. Air Intake Snubbers are commonly used in series with a removable filter element to insure clean intake air.

Diesel Governors

THE magazine *Control,* published by the Pierce Governor Company contains a discussion of governors for all types of internal combustion engines in the new issue now being sent to design and production engineers from the home office of the company.

Applying the principle of centrifugal (flyball) control, the Pierce governor is adapted through more than 3,000 different models to almost every type of work and engine. The publication, *Control No. 2* presents some typical installations of the four major types of governors: constant speed, full range, automotive type diesel, and road speed governors.

For a copy of this technical approach to governors and the problem of power regulation write to The Pierce Governor Company, Anderson, Ind.

New Caterpillar Booklet

CATERPILLAR Tractor Co. has produced a new publication *Caterpillar Diesel D2 Tractor* to present the design features and range of applications of the company's 32-hp. track-type tractor. Profusely illustrated and graphic in content, the booklet portrays the engineering of the product, its manufacture and its application in a wide range of chores to which it is put by users.

Copies of the publication may be obtained by writing Caterpillar Tractor Co., Peoria 8, Illinois, requesting Form 11628.

Order Your Copy of the 1948 DIESEL ENGINE CATALOG, Vol. 13 now. Thoroughly revised — more complete — indispensable. Convenient order coupon on page 78 this issue. Mail it today.

New Nordberg Bulletin

NORDBERG Manufacturing Co. announces publication of Bulletin 163 on Nordberg Diesel Engines, Type DB-24, for stationary and marine service for Duafuel or oil burning operation, supercharged and non-supercharged.

This eight-page two color bulletin describes and illustrates a vertical, four-cycle, single acting, trunk piston type engine of 16½ in. bore and 24½ in. stroke. Ratings range from 815 to 1900 hp. at speeds of 277 and 300 rpm. Sizes range from five to eight cylinders.

The DB-24 type engine is produced by the Busch-Sulzer Bros. Diesel Engine Company Division of Nordberg in St. Louis, Mo. Sectional views, job installations and parts pictures illustrate Bulletin 163. Specifications and ratings are also given. Bulletin 163 is available free upon request.

LET'S ALL FIGHT THIS

The advertisement reproduced herewith appeared in newspapers throughout the country early in February, under sponsorship of local Railroad Presidents' Committees. It speaks for itself. —The Editor.

China Honors F. W. Wilkening

F. W. WILKENING, president of the Wilkening Manufacturing Company has been awarded the Decoration of the Order of Yun Huei by the Chinese government. In a recent communication Wellington Koo, Chinese Ambassador to the United States, announced the award citing Mr. Wilkening for his company's valuable services to China during and since the war.

Davisson Joins Young Radiator

GORDON DAVISSON has recently joined the staff of Young Radiator Company as an Engineering Representative. Davisson began his business career with International Harvester Co. After service in the Army Air Force, he was appointed Chief Sales Engineer for Linear, Inc., a position he held until joining the Young Radiator Company, Racine, Wisconsin.

Engineering Societies Meetings Scheduled

S.A.E. National Meetings

1949

Passenger Car, Body and Production Meeting	Book-Cadillac Hotel	Detroit, Mich.	March 8-10
Transportation Meeting	Statler Hotel	Cleveland, O.	March 28-30
Aeronautic and Air Transport Meeting	Hotel New Yorker	New York, N. Y.	April 11-13
Summer Meeting	French Lick Springs Hotel	French Lick, Ind.	June 5-10
West Coast Meeting	Multnomah Hotel	Portland, Ore.	August 17-19
Tractor (possibly diesel)		Milwaukee, Wisc.	September

A.S.M.E. National Meetings

Oil and Gas Power Division	Hotel Sherman	Chicago, Ill.	April 25-29
Spring Meeting		New London, Conn.	May 24
Semi-Annual		San Francisco, Cal.	June 27-30
Fall Meeting		Erie, Pa.	Sept. 28-30
Annual Meeting	Hotel Pennsylvania	New York, N. Y.	Nov. 27-Dec. 2

Increased Trend to Dual Fuel Engines Predicted by Prominent Diesel Engineer

Ralph L. Boyer, Vice President and Chief Engineer, Cooper-Bessemer Corporation

"A SUBSTANTIAL percentage of the diesel engines produced in America over the next several years will be of the Dual Fuel or Gas-Diesel type." This prediction was made by Ralph L. Boyer, Vice President and Chief Engineer of the Cooper-Bessemer Corporation, before the annual meeting of the Society of Automotive Engineers in Detroit. Several cost saving benefits will largely account for this growing preference for diesel engines that can be operated either on gas, on oil or on any combination of gas and oil, as may be determined by the supply and cost of either fuel.

In sections of the country where the gas supply is subject to sudden cut-off as under adverse weather conditions, the Dual Fuel or Gas-Diesel engine will assure operators like municipal and industrial power plants of uninterrupted power generation. With this type of engine, if the gas supply is curtailed, the engine control will automatically switch over to oil-diesel operation, drawing entirely upon the fuel oil supply and maintaining a constant fuel input to the engine. As the gas supply is restored, the engine controls again provide proper compensation by decreasing the rate of fuel oil injection and correspondingly increasing the gas input. "As a matter of fact, this very feature enables the operator of the Dual Fuel engine to get a still better cost rate from the gas supplier," Mr. Boyer goes on to explain, "for in his contract it can be arranged that he, the user, may be cut off should the gas supplier find it necessary to do so."

The Dual Fuel or Gas Diesel engine is a highly efficient power plant by all known standards today. Its 40% brake thermal efficiency (at full load, supercharged) produces a brake horsepower

hour at no more than 6400 BTU. The average automobile engine approaches only 25% thermal efficiency under ideal operating conditions. As Mr. Boyer further points out, "We are extremely proud of this performance since a 40% brake thermal efficiency is very close to the theoretical maximum given us by thermo-dynamics experts. We have a feeling that we are going to meet their theoretical figures as we still have traces of raw or unburned gas in the exhaust."

According to reports from sections of the country where natural gas sells for 65c per thousand cubic feet, the Dual Fuel engine averages savings of about $25,000 each year, compared to diesel operation, for every 1,000 horsepower developed. "At Cooper-Besemer's Grove City, Pa. plant," Mr. Boyer explains, "we pay 65c per thousand cubic feet for gas and 13½c per gallon for fuel oil. With the Dual Fuel engine, our saving is around $17,000 per year over the conventional spark-ignited gas engine and over $23,000 a year for every 1,000 horsepower on straight oil diesel operation."

Oil field drilling should also be mentioned. In this field gas costs nothing. However, gas is frequently not available, particularly in wildcatting and drillers must therefore start out with straight oil diesel operation. Since at remote wildcatting sites 14c oil is not uncommon, for each 1,000 horsepower the driller will save $60,000 per year, based, of course, on that many horsepower hours being developed during the year. To show that this condition isn't particularly out of line, we point out that the modern rotary drilling rig frequently requires 2,000 horsepower.

With the Dual Fuel engine, the power output has been increased 75% over the conventional gas engine. To the operator, this means considerably less cost in the construction of engine foundations and building coverage. In light of the 40% brake thermal efficiency, the reduction in cooling water needed for engine water jackets further simplifies the engine installation and cuts the cost of supplementary equipment. In addition, engine performance records further indicate a definite reduction in lubricating oil consumption over that existing in conventional oil diesels.

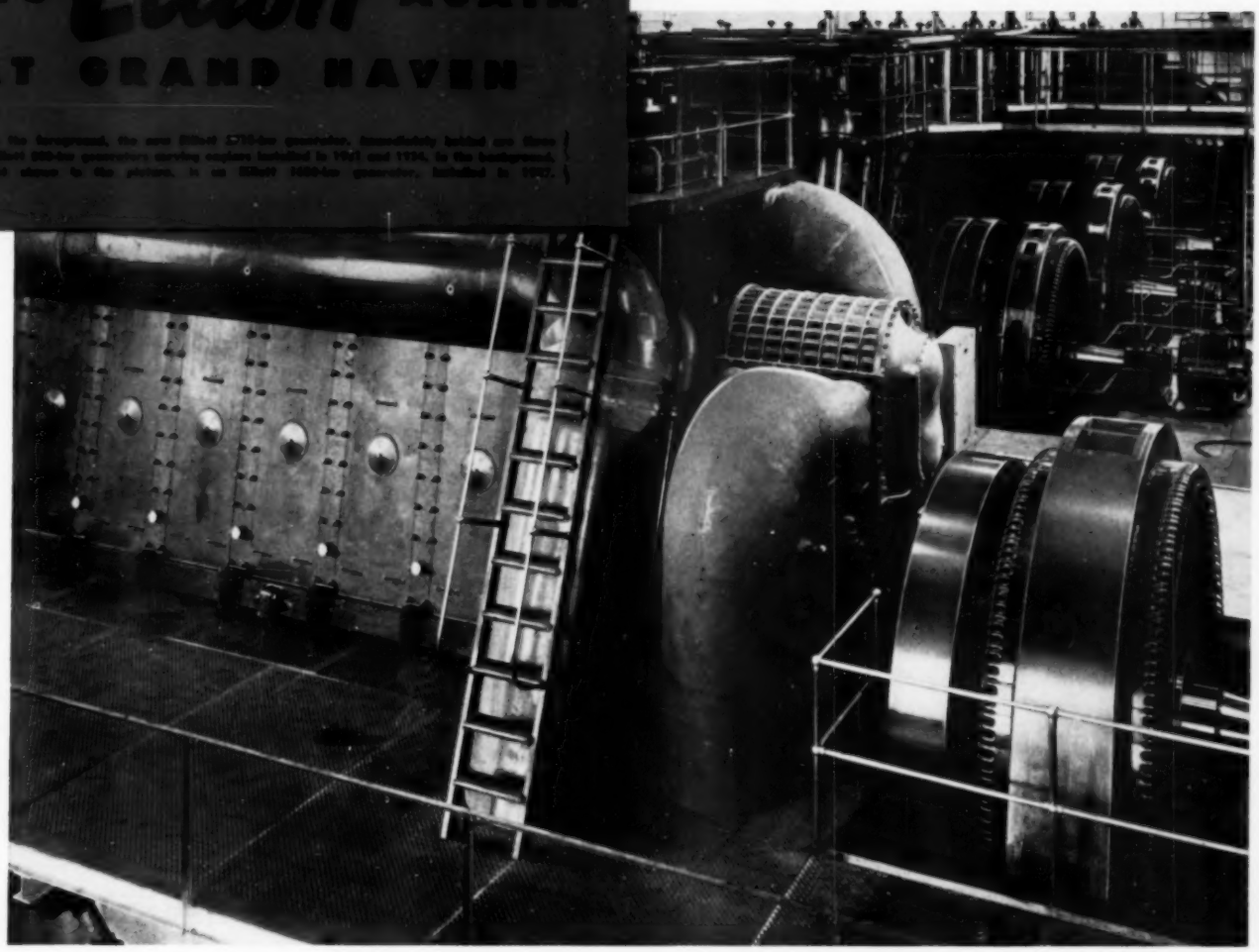
Auto-Lite Names Eastern Sales Manager

RUSSELL W. HIGGINS has been recently named Sales Manager for the Eastern Division of the Merchandising Division of The Electric Auto-Lite Company. Mr. Higgins' entire business career has been with the Auto-Lite, having joined the company in 1937 after graduating from Amherst College.

ADVERTISERS' INDEX

IT'S *Elliott* AGAIN AT GRAND HAVEN

In the foreground, the new Elliott 2750-kw generator, immediately behind are three Elliott 2000-kw generators driving engines installed in 1931 and 1934. In the background, not shown in the picture, is an Elliott 2000-kw generator, installed in 1937.



The fifth Elliott Generator . . .

at the progressive Grand Haven, Michigan, municipal power plant, is now spinning out the kilowatts, its output helping to make this one of the largest Diesel generating plants actually operating in this country, with a total installed hp of 13,300.

Since 1931, when Grand Haven installed its first Diesel engine-generator, Elliott has been the overwhelming favorite for the generating end of its constantly added Diesel units. Performance brings its own reward—in repeat orders.

This latest generator is of the new Elliott Fabri-Steel type, with stator and frame of welded steel, stiff, strong, crack-proof and enduring. It has also the latest Elliott developments in long-lived insulation and taping of windings, silver brazed damper winding joints, extra bracing of stator windings, and many features aiding low cost maintenance.

Elliott Fabri-Steel generators are described in Bulletin PB-2000 — on request.

ELLIOTT COMPANY
Electric Power Department, RIDGWAY, PA.

J-718

ELLIOTT COMPANY *Plants in:* JEANNETTE, PA. • RIDGWAY, PA. • SPRINGFIELD, O. • NEWARK, N. J.
DISTRICT OFFICES IN PRINCIPAL CITIES

Like two trips around the world without an overhaul!

The Frances M. Hougland, built by Nashville Bridge, is powered by these two supercharged 1,100 hp Cooper-Bessemer Diesels.

If you want to use trouble-free mileage as a yardstick for diesel performance, look at the record of the Frances M. Hougland. This Cooper-Bessemer-powered boat traveled 57,170 miles and delivered 1,400,300 barrels of gasoline before needing her first overhaul!

And they were fast miles, too! For example: despite a 44-hour loss in loading and fog, she made the round trip between Paducah and Fort Arthur in only 15 days, with a 44,000 barrel load!

Records like this give pretty good evidence that Cooper-Bessemer power is your best bet for prolonged economy in workboat performance.

The
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